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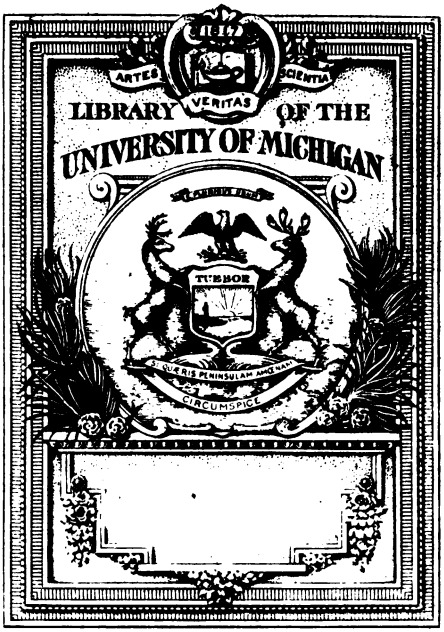
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THE

SCIENCE RECORD

FOR

1874.

A COMPENDIUM

OF

SCIENTIFIC PROGRESS AND DISCOVERY

DURING THE PAST YEAR.

WITH ILLUSTRATIONS.

EDITED BY ALFRED E. BEACH.

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PREFACE.

We take pleasure in presenting herewith our summary, in brief, of the interesting facts pertaining to science, that have come under our notice during the year just closed.

The gratifying success which has attended our previous issues, and the large demand for copies of the present work, in advance of its actual publication, will encourage the efforts of the publishers in beautifying and improving the contents of future volumes.

For the information of those who may wish to possess the complete series of volumes, we would state that SCIENCE RECORD was commenced as an annual work, in 1872. The present is therefore the third book of the series. The publishers have reprinted the SCIENCE RECORD for 1872 and 1873, and will hereafter be able to fill orders for any of the volumes.

The Index of References given at the end of the volume indicates the sources whence most of the information here presented is derived. The numbers at the foot of the various articles refer to the works named and enumerated in the above index.

NEW-YORK, January, 1874.

BARON JUSTUS VON LIEBIG.

SCIENCE RECORD.

CHEMISTRY AND METALLURGY.

THE ARTIFICIAL FORMATION OF ORGANIC SUBSTANCES.

By Dr. Henry E. Armstrong, F.C.S., Professor of Chemistry, London Institution.—From marsh-gas or methane, by a series of operations similar to those whereby ethane is converted into ethylic alcohol, an alcohol is obtained which proves to be identical with methylic alcohol, or wood-spirit, one of the main products of the destructive distillation of wood. These alcohols serve as the starting-points for the preparation of other hydrocarbons and alcohols, bearing relations to each other similar to those which obtain between methane and ethane, and between methylic and ethylic alcohols. Many of the alcohols, as prepared artificially, are identical with the alcohols which are obtained, together with ordinary alcohol, by fermenting saccharine substances, or which exist in the form of compound ethers in the ethereal oils extracted from various plants.

A long series of products is obtained by the oxidation of alcohol. This is first deprived of a portion of its hydrogen and converted into aldehyde, which latter is then converted by direct assumption of oxygen into an acid—ethylic alcohol, yielding acetic acid, the acid of vinegar. The other terms of the series of alcohols to which ordinary alcohol belongs are acted upon in like manner, and thus a series of aldehydes and acids is obtained. Many of these acids are identical with those which enter into the composition of the natural fats. The aldehydes are extremely alterable compounds, and readily undergo change, almost spontaneously in fact, being converted into bodies of more complex composition.

Formic aldehyde, the aldehyde of methylic alcohol, is probably formed in plants from the carbon and oxygen

of the carbonic acid of the atmosphere, (whence, as is well known, plants derive their carbon,) and the hydrogen from water. One of the simplest transformations of formic aldehyde is its conversion into sugar; this conversion, however, has not yet been effected artificially, although formic aldehyde has been converted into a substance closely resembling the natural sugars. The aldehydes combine directly with ammonia, and the products readily part with the elements of water and are converted into alkaloids, one of which, that obtained from butyric aldehyde, is identical in nearly all respects with conine, the poisonous alkaloid of hemlock.

A variety of interesting derivatives is also obtained from the acids of the acetic series, such as glycocine, leucine, glycollic and lactic acids, all of which are substances found in various mineral fluids. (106)

DIRECT DETERMINATION OF THE ELEMENTS OF ORGANIC SUBSTANCES BY A SINGLE COMBUSTION.

MITSCHERLICH has recently discovered a new mode by which, by direct analysis, not only the carbon, oxygen, and hydrogen in an organic substance can be determined, but also the chlorine, bromine, sulphur, iodine, phosphorus, and probably also the nitrogen therein contained. The organic material is brought to combustion with oxide of mercury, the results of which process are water, carbonic acid, and mercury. The two former are weighed in the ordinary manner. The weight of the mercury formed serves to determine the quantity of oxygen due to combustion, by subtracting which from that contained in the carbonic acid and the water, the total amount of oxygen existing in the substance submitted to elementary analysis is found. If, however, the body under examination contains chlorine, bromine, or iodine, these elements combine with the mercury set free, and are determined by weighing. Sulphur and phosphorus combine in the state of sulphate and of phosphate of oxide of mercury.

SULPHUR, SULPHURIC ACID, ETC., FROM GAS-LIME.

JULIUS KIRCHER, of New-York, states that sulphur, sulphuric acid, and the sulphurets of sodium and potassium may be obtained from gas-lime by heating it to 300° F. in a closed retort, and passing steam at 600° F. over it, evolving sulphureted hydrogen, which passes to a leaden chamber, and is there supplied with air and ignited to produce sulphurous acid; it is then mixed with nitric acid vapors, when the reaction produces sulphuric acid. The

gas-lime is then mixed with clay, loam, or sand, and subjected to heat, when the silica or alumina unites with the lime and with oxygen, forming silicate of lime, etc., and liberating the sulphur. To produce the sulphuret of sodium or potassium, the gas-lime, etc., should be mixed with caustic soda or potassa, and allowed to stand until the reaction takes place.

ACTION OF SULPHUROUS ACID UPON INSOLUBLE SULPHIDES.

LANGLOIS having proved that alkaline sulphites are converted into hyposulphites by the action of sulphurous acid, another chemist named Guerout has repeated the experiment with the sulphides of other metals, and finds that the sulphides of copper, silver, gold, platinum, and mercury are not attacked. The sulphides of manganese, zinc, and iron readily dissolve in a strong solution of sulphurous acid, being at the same time converted into hyposulphites. The sulphides of cobalt, nickel, cadmium, bismuth, tin, arsenic, and antimony are slightly soluble, and undergo the same change into hyposulphites; varying quantities of sulphureted hydrogen are evolved, and sulphur separates. Further experiments, however, indicate that the sulphides are not converted directly into hyposulphites, but are first converted into sulphites which are afterward changed into hyposulphites.

This easy and rapid method of preparing hyposulphite of iron, zinc, etc., having been discovered, it remains to apply it to new and important uses, and such, we doubt not, will soon be found.

SULPHITE OF SODA AS AN ANTICHLOR.

THE term antichlor, which applied originally to any substance employed to destroy the free chlorine remaining in fabrics bleached with it, is now almost entirely limited to hyposulphite of soda, $Na_2S_2O_3$. During the reaction of this salt upon chlorine, free sulphur is deposited upon the fabrics, much to their detriment. The probable reason that this has never before been observed, is because its injurious effects have been attributed to over-bleaching. This finely divided sulphur, when deposited in the fibre of paper, gradually oxidizes to sulphurous and sulphuric acid, which renders the paper brittle, and, if written upon with iron ink, bleaches or fades it. This effect upon paper has sometimes been attributed to its containing too much wood-fibre.

A larger quantity of active sulphurous acid can be obtained from a given weight of sulphite of soda, Na_2SO_3, than from an equal weight of the hyposulphite, and from

this no sulphur is deposited, so that it ought most certainly to be preferred for use as antichlor on a large scale. We are informed by large manufacturers of chemicals that sulphite of soda can be made at a price not higher, in proportion to its efficiency, than the hyposulphite.

A PHENOMENON OF CAPILLARITY.

A CURIOUS experiment, due to capillary attraction, was described at a recent session of the French Academy of Sciences. It consists in placing in a flask a small quantity of bisulphide of carbon, and inserting in the liquid a small tight roll of filtering paper, which passes up through a hole in the cork. Owing to the porosity of the paper, the bisulphide ascends; and on coming in contact with the atmosphere, evaporates very rapidly. A temperature is thus produced of very nearly 0° Fah., under ordinary circumstances. The water held in a vaporous condition in the air is consequently condensed and precipitated in the state of hoar-frost, which, with the bisulphide, forms, it is said, a peculiar hydrate, which is deposited on paper in a white layer. As new quantities of the bisulphide are continually supplied, the phenomenon continues until a mushroom-shaped excrescence, perhaps an inch in height and broad in proportion, surmounts the flask.

MM. Dumas and Chevreul suggest that this may ponit to the explanation of certain geological phenomena, such as ferruginous and calcareous concretions, of which the forms are identical with that of the artificial stalagmite described.

SOLIDIFICATION OF NITROUS OXIDE.

ACCORDING to Wills, nitrous oxide may be easily solidified by causing a rapid current of air to pass through the liquefied gas. Differing in this respect from carbonic acid, nitrous oxide may be kept liquid for some time in open vessels. Carbonic acid solidifies as soon as it escapes from its containing reservoir, because the tension of the vapor of the solidified acid, even at the moment of its formation, is considerably superior to atmospheric pressure; while liquid nitrous oxide attains—133° Fahr. and solidifies at —146°, so that the tension of its vapor is weaker than one atmosphere. The density of the liquid protoxide at 32° Fahr. is equal to 0.9004; its coefficient of dilatation is very considerable. It is insoluble in water.

INFLUENCE OF PRESSURE ON FERMENTATION.

THE results of an extended series of experiments by Prof. H. T. Brown show that a diminished atmospheric pressure tends to retard in a remarkable manner the progress of alcoholic fermentation.

MANUFACTURE OF ALKALINE CARBONATES.

HECTOR DE GROUSILLIERS, of Berlin, states that the alkaline carbonates may be manufactured from their haloid salts by introducing the latter, together with an alcoholic solution of carbonate of ammonia, into a closed vessel lined with lead and heated by steam, until a pressure of five atmospheres is obtained, whereby the alkaline carbonate is precipitated, the chloride of ammonia remaining in solution.

NEW EXPLOSIVE COMPOUND.

MESSRS. NOIRBIN AND OHLSON, of Stockholm, state that nitrate of ammonia is not ordinarily considered as an explosive of much power; but they have discovered that, if suddenly highly heated, as by the intense heat of an explosion, great force is exerted by an explosive of which this forms one of the ingredients, and they therefore propose to form a compound of eighty parts of nitrate ammonia, six to eight parts of coal, (both finely pulverized,) and from ten to twenty parts of nitro-glycerine, which will form a pasty mass that may be made into cartridges. The explosion of the nitro-glycerine will generate sufficient heat to make the nitrate of ammonia a powerful explosive agent.

REAGENT FOR BORACIC ACID.—The flame of illuminating gas, says M. Bidaut, is a very delicate reagent for boracic acid. If a solution of the acid in water in the proportion of $\frac{1}{2100}$ be boiled and the flame placed in the vapor, a green tint in the light will be plainly visible, and will become more apparent as the concentration of the liquid advances. This effect is more strikingly obtained by directing the flame upon a minute crystal of the acid, placed on a piece of porcelain. A magnificent green light will be produced.

ACTION OF NITRIC ACID ON CHROMATE OF LEAD.—On treating chromate of lead with about double its weight of nitric acid, a solution of chromic acid is obtained, according to M. E. Duvillier, containing but two per cent of oxide of lead. It is considered that the nitric acid decomposes the chromate of lead into chromic acid and nitrate of lead, which precipitates itself on boiling in presence of the excess of nitric acid employed.

DETERMINING ANILINE COLORS.—The *Chronique de l'Industrie* describes a new method, the principle of which consists in the fixing of the coloring matter to be tested on a plate of glass, by means of collodion. The thin film thus obtained is compared with another of the typical coloring material prepared in the same manner.

A NEW METHOD OF TESTING WITH BUNSEN'S FLAME.

By Charles Huson.—A small double loop is made at the extremity of a thin platinum wire; the loop is dipped in moistened cream of tartar, and the latter carefully carbonized by holding it for a few seconds in the Bunsen flame. The porous mass is dipped into a solution of the substance to be tested, or if the substance be solid, a small portion is attached to it, and then inserted into the upper reducing flame.

If the metal be reducible, small metallic grains will be visible upon careful examination; but if volatile, a mirror will be readily obtained by holding a small evaporating basin, half filled with water, just above and almost in contact with the carbon extremity. In testing for a volatile metal, the deposition of soot must be carefully avoided, but the gases resulting from imperfectly-burned tartar are advantageous in the case of non-volatile substances.

Some test-experiments are quoted, from which it appears that quantities so small as 0.000075 gramme of As, 0.00013 Cu, 0.00008 Ag, are capable of being detected by the above method of operating. (2)

USES OF TUNGSTEN.

In the last few years, the consumption of tungsten and its compounds has vastly increased. It is now used for improving the quality of puddled iron and steel as well as cast-steel, and is one of the constituents of Mushet's special steel. Its addition to German silver renders it tougher, and it is employed in many other alloys with gold, silver, lead, etc. One alloy called minargent contains 100 parts copper, 70 nickel, 5 tungsten, and 1 aluminum. Bartels in Hanover makes a large number of tungsten preparations for use in dyeing and printing; the tungstate of soda serves as substitute for tin salt, for fire-proofing fabrics, and for the manufacture of bronze powder and blue carmine. In cosmetics, tungsten is taking the place of white-lead and zinc. Tungsten in steel gives it the property of retaining magnetism for a longer time and makes it useful for magnetic needles.

CONVERSION OF STARCH INTO SUGAR.

The conversion of starch, cellulose, and the like into glucose or grape-sugar has usually been accomplished by the use of dilute acids in open vessels. Some Parisian chemists, Gibon, Dusart, and Bardy, now propose to conduct this operation in closed cylinders under a pressure of 3 to 4 atmospheres. The proportions taken are 35.3 cubic

feet water and 4.4 pounds sulphuric acid to 4400 pounds dried starch, and the operation lasts two hours. If a thicker syrup is desired, it is only necessary to diminish the amount of water taken. Some other acid may be used than sulphuric. The advantage of the process consists in obtaining the desired product by a single operation, since neither concentration by evaporation nor filtration is necessary.

HOW TO CLEAN GREASY VESSELS.

DR. WALZ has suggested a method for cleaning greasy beakers and photographic glass plates, which must at once commend itself to all practical chemists and photographic operators. He takes a dilute solution of permanganate of potash, (kept on hand in a large stock bottle,) to which a few drops of hydrochloric acid are added when used; and he pours in enough to wet the sides of the vessel to be cleaned. The greasy impurities are at once oxidized and removed. The method is preferable to the employment of bichromate of potash and sulphuric acid. The permanganate of potash solution can be saved and used repeatedly until, by the exhaustion of its oxidizing power, it ceases to act.

PURIFYING CARBONIC ACID GAS.

THE impurities contained in carbonic acid gas when derived from the combustion of coke, coal, etc., may be removed, according to Asa P. Maylert, of New-Britain, Ct., by passing the gas, as it issues from the furnace, through or over a mixture consisting of deutoxide of lead held in suspension in water, or a weak solution of acetate of lead, or of some other soluble salt of lead.

A NEW MODE OF FILTRATION.

BY ISAAC B. COOKE.—A 300 c.c. flask is fitted with a perforated india-rubber stopper, through which a narrow glass tube of about 6 inches in length is passed for a distance of one inch. The lower end of the tube is drawn out to a fine point, and the other is slightly enlarged in form of a funnel. Into this funnel-shaped mouth a small quantity of cotton-wool is gently packed for about half an inch, and the remainder of the wool is left outside in the form of a spreading brush. To utilize this arrangement, some water is poured into the flask, and the air expelled from the latter by steady ebullition; the stopper is inserted at the right moment, and, when condensation begins, the flask is inverted and the tube with its brush of cotton-wool plunged into the liquid to be filtered, the latter being contained in a small porcelain dish of about 2½ inches in diameter. When nearly all the liquid has

been drawn up, a stream of distilled water may be directed upon the precipitate to wash it, and the washing can be repeated as often as necessary. The cotton plug is subsequently removed by forceps over the evaporating-basin, and the end of the tube having been cleansed from adhering precipitate, the basin with its contents is dried over a lamp, ignited, and weighed. (2)

RAPID FILTRATION.

A SIMPLE contrivance, acting upon the same principle as Bunsen's filter, has been proposed by E. Fleischer. A wide-mouthed bottle is closed with a rubber cork twice perforated; into one of the perforations a funnel is fitted, while a short glass tube, bent at a right angle, is inserted into the other, and lengthened by means of a piece of rubber tubing with spring-clamp attached. The filter is capped with a small filter, then inserted and well moistened so as to rest against the funnel; afterward, the liquid to be filtered is poured upon it, and the air in the receiving-bottle rarefied by sucking through the rubber tubing, which is then closed by the clamp. (60)

CODEINE.

THIS substance, which is also called *codea*, is beginning to find use in medicine, and some description of its properties as well as the method of its preparation may be of interest to some of our readers. Codeine, like morphine, narcotine, and several other alkaloids, occurs in opium. It was discovered by Robiquet in 1832. These alkaloids exist in opium in combination with certain vegetable acids, principally meconic acid. To obtain the codeine, it is first necessary to remove the meconic acid. An aqueous infusion of opium is evaporated to a syrup and mixed with a solution of chloride of calcium, which precipitates the acid as meconate of calcium, leaving the hydro-chlorate of morphine and hydrochlorate of codeine in the solution, from which they crystallize if left to rest. These crystals are dissolved in water, and the solution, after purification with animal charcoal, is precipitated by ammonia, which separates the greater part of the morphine, leaving the codeine in solution. The filtered liquid is evaporated over a water-bath to expel the excess of ammonia, the morphine salt remaining in the solution being at the same time precipitated; the saline solution is concentrated and precipitated by caustic potash, and the precipitate of codeine is washed, dried, and dissolved in ether, whence it is deposited in crystals. From 100 lbs. of opium only 6 or 8 ozs. of codeine is obtained. Codeine is more soluble in water than morphine; it is also soluble in alcohol, ether,

and ammonia, but it is quite insoluble in potash. It has a strongly alkaline reaction, restoring the blue color of reddened litmus, and precipitating the salts of lead, iron, copper, cobalt, nickel, etc.

The physiological effects of codeine resemble those of morphine in many respects. According to Robiquet, a dose of 0.3 or 0.4 of a grain produces in 24 hours, especially in an excitable person, a sensation of comfort and repose and a refreshing sleep, and a dose of from 1.8 to 2 grains produces heavy sleep with a feeling of intoxication after waking, sometimes also nausea and vomiting. More than 3 grains in 24 hours can not be taken without danger of serious consequences.

FLUORENE.

M. BERTHELOT announces, under the name of fluorene, a new and very fluorescent carburet contained in the portions of the tar of volatile oils between 300° and 340° C.

In order to extract the substance, instead of causing the portions of solid carburet which have passed the distillation between 300° and 305° C. to be crystallized in alcohol simply, a mixture of alcohol and benzine is used. By this means may be separated a small quantity of acenaphthene which remains in the mother liquor. The point of fusion of the mass, which is ordinarily 105° C. after the first distillation and crystallization in pure alcohol, increases to 112° after crystallization in alcohol mixed with benzine. The remainder of the purification consists in redistillation and crystallization in pure alcohol. The carburet possesses a quite pronounced violet fluorescence, which, however, disappears promptly on its being exposed to the light. The chemical symbol is stated to be C^{26} H^{10}.

PURE SUB-IODIDE OF MERCURY.

LEFORT recommends the following method for preparing the sub-iodide of mercury free from iodine and from metallic mercury: 60 grains of pure crystallized pyrophosphate of soda are dissolved in 300 grains water, and 30 grains acetate of the suboxide of mercury added. The solution requires several hours, during which it is frequently shaken. If the soda salt is chemically pure, the mercury salt dissolves perfectly; but this is seldom the case, and the excess of alkali precipitates some oxide of mercury, so that the solution requires filtering. It is then still further diluted with water, and a solution of 30 grains iodide of potassium in 2 ounces of water gradually added with constant stirring or shaking. This produces a precipitate which is at first a brownish green, but becomes a bright green, closely resembling oxide of chromium, and

on settling acquires a yellow-green color. If the mercury solution contains any mercuric salt at the start, some biniodide of mercury is formed, giving the liquid a pinkish color; but this is easily avoided by adding a slight excess of iodide of potassium, which is so dilute as not to decompose the sub-iodide, while it is able to dissolve the biniodide. The precipitate is washed with cold water by decantation, collected on a filter, and dried with gentle heat in the dark.

CRYSTALLINE MERCUROUS IODIDE.

By P. Yvon.—By heating the required proportions of mercury and iodine in a closed flask on the sand-bath, at a temperature not exceeding 250°, the author has obtained mercurous iodide condensed on the upper part of the vessel in well-defined rhombic crystals, of a magnificent garnet-red color, which become yellow on cooling. If carefully heated, the compound sublimes unchanged; but if rapidly heated, the crystals melt at 290° to a black liquid, which boils at 310°, mercury being given off, and a pale yellow crystalline sublimate obtained, which appears to be an oxyiodide, perhaps of the composition $6HgO.7HgI$. (4).

FORMATION OF CRYSTALLINE ANTIMONY.

The antimony is deposited on copper from a hydrochloric acid solution of antimonious chloride. On removing it, and pulverizing it in a mortar, it detonates, and is changed from the amorphous to the crystalline condition. The author has not observed if this result is produced by heat, as is the case with rhodium and iridium.—W. R. *Dingl. polyt. Jour.*, ccvii. 427.

OZO-BENZINE—A NEW EXPLOSIVE.

MM. Houzeau and Renard state that, by causing concentrated ozone to react upon pure benzine boiling at 178° Fah., a solid body is formed of gelatinous appearance, to which the name of ozo-benzine has been given. The formula is $C^{12}H^6$ (C^2 $6H^6$). Dried in *vacuo*, the substance becomes solid, white, amorphous, and highly explosible. It detonates with violence under the influence of shocks or heat. A few grains exploded in the laboratory shattered the glass in the windows. It is very unstable, and when left either in air, carbonic acid, or even in a vacuum, it changes rapidly. Among the products of the aqueous decomposition of ozo-benzine, is noted the presence of acetic and formic acids, and also that of a solid acid, very soluble, becoming colored brown by potash or soda. Another composition is also formed which has an agreeable odor and no acid reaction.

It has also been noted that a mixture of bicarbureted hydrogen and ozone detonates violently without the action of light, heat, or electricity. The ozone must be strongly concentrated.

PREPARING AMMONIA SALTS.

BOBROWNICKI, of Paris, proposes to prepare ammonia salts from the ammonia liquor of gas-works, by acidifying and then treating it with fluoride of silicon, chloride of silicon, hydrofluor-silicic acid, or an alkaline silicate. The silicon compounds carry down the suspended bodies, and those in solution, and hold them in a solid or half-solid form. Bobrownicki calls the precipitate a silicoid. It furnishes the crude material for preparing ammonia salts in the usual manner.

PHOSPHORESCENT MIXTURES.

PHOSPHORESCENT tubes have been sold in France and Germany for several years, but the method of their preparation has not been divulged. Dr. Seelhorst, of Nuremberg, has been experimenting on the subject, and very considerately makes public the best way to secure mixtures that will afford all the colors of the rainbow and are capable of use in imitations of flowers, insects, and objects of natural history. After the powders are prepared, they can be stirred into melted paraffine; and by means of a brush, any pattern or design may be put upon glass. By protecting the glass in a frame, the powder will retain the property of glowing for a year or more. The putting of phosphorescent mixtures upon glass in the form of flowers is capable of very beautiful application, and is one that has not been very extensively practiced. With proper care and study, a landscape could be drawn on glass which, after exposure to sunlight, would shine in the dark and form a picture of considerable duration. The use of the paraffine is to protect the powders from the action of moisture and prevent decomposition. As a general rule, it is better to hermetically seal the mixtures in flat bottles, when they will retain their good properties for years. The following colors can be obtained very readily:

Green.—Hyposulphite of strontia, heated for 15 minutes over a Berzelius lamp and for five minutes over a blast-lamp until it is fused, yields a yellowish-green color after exposure to sunlight. The same color can be obtained by taking equal parts of carbonate of strontia and *lac sulphuris*, heat gently for 5 minutes, then strongly for 25 minutes over a Bunsen burner, and finally five minutes over a blast. It is granular and yields a fine green color, darker than the preceding.

Blue.—Sulphate of strontia is prepared by precipitating with sulphuric acid from chloride of strontium; the precipitate is dried, heated in a current of hydrogen gas, then over a Bunsen burner for 10 minutes and for 15 or 20 minutes over a blast-lamp. The product sometimes yields a yellow phosphorescent light, and when this is the case, it is necessary to give it another turn over the blast-lamp.

Yellow.—Sulphate of baryta, 6 parts; charcoal, 1 part, fused over a blast-lamp, at first afforded no light, but after 24 hours gave an orange-yellow light.

It may not be generally known that magnesium light will suffice to bring out all the effects of phosphorescence nearly as well as sunlight.

A NEW ACID.—TAURO-CARBAMIC ACID.

By H. Salkowski.—The author has already shown that when taurin is administered to the human subject, a portion passes unaltered into the urine. He now finds that the greater part of the taurin becomes transformed into an acid containing the elements of 1 molecule of taurin and 1 molecule of carbamic acid minus 1 molecule of water.

The new acid, *tauro-carbamic acid*, $C_3H_8N_2SO_4$, is obtained by precipitating the urine with acetate of lead, removing the lead from the liquor by hydrosulphuric acid, evaporating the filtrate, and adding alcohol to the concentrated solution. The crude sodium salt which then separates must be treated with animal charcoal and afterward decomposed by sulphuric acid. The crude acid may now be extracted by alcohol, which leaves it, on evaporation, in the form of a syrup which must be freed from sulphuric acid by means of barium hydrate, and from chlorine by means of silver carbonate.

Tauro-carbamic acid, when pure, forms anhydrous square leaflets, which are slightly hygroscopic in moist air. It is readily soluble in water, slightly soluble in alcohol, and insoluble in ether. When heated to 130°–140° with barium hydrate and water, it splits up into carbonic acid, ammonia, and taurin,

$$\begin{array}{l} CH_2 - NH_2 \\ | \\ CH.SO_3 \\ | \\ C = O.NH_3. \end{array} + BaH_2O_2 = C_2H_7NSO_3 + BaCO_3 + NH_3.$$

The *barium salt* forms anhydrous shining rhombic tables; the *silver salt*, tufts of long radiated crystals.

The researches of Schültzen render it probable that tauro-sulphamic acid is also excreted in the urine when taurin is exhibited, and the author finds that normal urine contains a trace of tauro-carbamic acid. (32)

ZINC AND ALUMINUM IN THE SUN.

THE observation that the number and length of the lines in the spectra of metallic vapors depend upon the density of the absorbing or radiating vapor, and that only the longest lines remain visible when the vapors are rarefied, obtains additional importance by the author's discovery that the inverted lines in the solar spectrum are without exception the longest lines observed in the spectrum of the vapor of each element. The presence of zinc and aluminum in the sun had hitherto been extremely doubtful, as only very few lines of their spectra had been found inverted in the solar spectrum; this doubt we may now consider as removed, since the author has found that the lines corresponding to these elements in the solar spectrum are the longest lines of the spectra of their vapors.—*N. Lockyer.*

QUALITATIVE ANALYSIS OF BENZINE.—Commercial benzine often contains quite a large proportion of petroleum, which leaves a disagreeable odor when the benzine is employed for the removal of grease. A small piece of pitch is placed in a test tube and the suspected liquid poured upon it. Pure benzine will readily dissolve the pitch, forming a tarry mass, while adulterated benzine will be less and less colored in proportion to the amount of petroleum contained in it. Coal-tar will dissolve easily in pure benzine, but forms distinct layers when impure material is employed for the solution.

ALCOHOL IN BREAD.

IN the ordinary process of bread fermentation, a portion of the sugar contained in the flour is decomposed and converted into alcohol. It has been heretofore supposed that by the heat of baking the whole of this alcohol was expelled, but recent experiments, made by Thomas Bolas, in London, indicate that a perceptible amount of alcohol still remains in yeast-raised bread after baking. The result of six experiments showed that one third of one per cent in weight o alcohol was obtainable from fresh baked bread; but the quantity of alcohol was much less in stale bread. From forty loaves of fresh bread, two pounds each, alcohol equal to one bottle of port wine may be extracted. From what is known as "aerated bread," or bread raised by mixture of carbonic acid gas with the dough, without fermentation, no alcohol can be extracted.

COMPOSITION OF THE PUFF-BALL.—Professor Church contributes to the *Journal of Botany* a note on the composition of the common fungus *Lycoperdon giganteum,*

known as the giant puff-ball, which he has found to be as follows:

	In the fresh state.		Perfectly dry.
Water	90.89	....	
Fat, oil, and resinous matter	.90	....	11.00
Albuminoids	5.48	....	66.78
Cellulose or fungine, etc	2.10	....	14.78
Ash or mineral matter	.63	....	7.44
	100.00		100.00

while an analysis of the ash gives the following results:

Phosphorus pentoxide	46.19
Potash	35.48
Soda	6.95
Lime	2.47
Ferric oxide	1.08
Silica	0.66
Other substances and loss	7.17
	100.00

GUN-COTTON FROM PAPER-PULP.

M. CHAMPION stated some of the results of his experiments in preparing gun-cotton by means of paper-pulp. The pulp, which had been sent for this purpose by M. Girard, was perfectly adapted for this preparation, if only care be taken not to use the pulp too wet or too dry. The formula for mixing the acid is the following, as stated by M. Mormott, of the Museum of Arts and Manufactures:

Nitric acid at 40° ..... 2 parts.
Sulphuric acid at 66° ..... 3 "

The former is obtained of the right strength by mixing equal parts of ordinary with fuming nitric acid. The mixture may be either cold or lukewarm. The cotton must be pure, and should be immersed in the acid for three minutes, and afterward washed as usual. When a paper-pulp is used in which the textile fabrics remain in a great state of purity, begin by rolling it into sheets on wire-cloth, upon which it is to be laid out. After complete desiccation, the sheet thus made is subjected to the acid as above indicated, and a product is then obtained which dissolves perfectly in a mixture of ether and alcohol, and which, besides, possesses the advantage of depositing with great rapidity such small parts of insoluble matter as are left, thus permitting the collodion to be used almost at once.

ACTION OF HEAT ON THE DIAMOND.

THE last contribution to science made by Gustav Rose before his death, a few months ago, records some interesting facts concerning the action of heat on the diamond and graphite. Rose found that by placing crystals of diamonds between carbon points *in vacuo*, and subjecting them to the action of a Siemens dynamo-electric appara-

tus, the diamond became red-hot, and eventually flew to pieces, the surface having at the same time acquired a black crust which had all the appearance and characteristics of graphite. Exposed to the temperature at which cast-iron melts, the diamond was found to undergo no change, but at the fusing-point of wrought-iron it became quite black and opaque, exhibiting a strong metallic lustre, and becoming in fact converted into a graphitic substance. But the most curious point in the behavior of the diamond is seen when the gem is heated in a muffle with access of air. Under these circumstances, the faces of the diamond exhibit regular triangular depressions, reminding one of the markings common on many of the South-African diamonds. (39)

GAS COMBUSTION.

ONE of the most important and suggestive papers read at the Liege meeting was a brief one by M. Charles Boutmy on the combustion of gases. The author holds that the complete combustion of a gaseous mixture can be brought about only on condition of the mixture being raised to and kept at the temperature requisite for the combustion of the gases. The process of combustion, even though commenced, is arrested by chilling the ignited mixture to the requisite degree. Gases issuing from chimneys, when subjected to analysis, have disclosed the fact that even at a temperature of 400° C., they still contain a notable quantity of combustible gases mixed with a proportion of atmospheric air several times sufficient to admit of their burning. We are entitled, therefore, to conclude that a temperature of 400° C. is insufficient to allow the combination of carbonic oxide and carbureted hydrogen with atmospheric air; and that boilers, the temperature of which rarely exceeds 155° C., produce upon ignited gases passing beneath them the same effect as does wire-gauze upon flame; and, as a result, we have a large part of the gaseous mixture passing off uncombined. To obviate this waste, the author insists on the necessity of burning the gases in a special chamber of fire-brick, the walls of which will become so intensely heated as to insure the complete combustion of the gases entering into it. This idea of a special chamber of combustion is not at all new. All of the modern hot-blast stoves are provided with them; yet the idea which led to their adoption was rather to secure equable distribution of heat and prevent the destruction of the pipes, than to effect complete combustion. It would certainly be a great gain in the economical use of blast-furnace and other combustible gases were the system to be extended to boiler-heating.

A NEW AGENT FOR DESTRUCTION OF HAIR.

PROFESSOR BÖTTGER states that sulphhydrate of sodium is now acknowledged as an agent destructive of hair. This sulphhydrate of sodium attacks the substance of the hair still more energetically than that discovered by him thirty-four years ago, the nauseous sulphhydrate of calcium with the odor of sulphureted hydrogen. This new agent can be readily obtained in a very convenient form by rubbing together intimately 1 part by weight of crystallized sulphhydrate of sodium with 3 parts by weight of fine purified chalk (carbonate of lime) to a fine powder. By moistening this mixture, which keeps for an unlimited length of time in well-closed glass vessels without suffering decomposition, with a few drops of water to a thick paste, and placing it in a layer of the thickness of a knife-back upon a hide covered with hair, it will be seen that the thickest hair is changed within a few (two or three) minutes into a soft mass easily removed from the skin with water. By prolonged action, the skin itself begins to corrode.

ANILINE FOR PRINTING BLACK.

THE degree of purity of commercial aniline, says the *American Chemist*, is of the greatest importance in the manufacture of different colors, and especially of blue and black. As aniline black is developed by printers themselves and not bought ready for use, the following test will enable them to determine the quality of the article they have to use:

Any aniline oil which does not boil under 192° C. must at once be rejected; and the nearer its boiling-point is to that of pure aniline, 180°, the finer will be the black color produced. For practical tests, several methods may be followed. Beaumé's areometer gives some indication of quality. Any aniline of from 20° to 30° B. always gives a black color if not fraudulently adulterated. If heavier, it generally contains undecomposed nitro-benzol; if lighter, too much toluidine. Fractional distillation gives a more reliable result. The percentage of aniline distilling between 180° and 185° C. represents the true value of the article. Concentrated sulphuric acid diluted with three times its weight of water is also a good test. About one part of aniline is mixed with at least three parts of the dilute acid; a thick paste of sulphate of aniline is formed, and more water is added to dissolve the salt, when any tarry impurities and also nitro-benzol collect at the top.

The quantity of aniline oil used is enormous, being, in 1869, 3,500,000 pounds, or about 10,000 pounds per day. Of

this, Germany took two million pounds, and the rest was divided between Switzerland, England, and France. The quantity of coal which must be converted into gas to furnish sufficient benzol for 3,500,000 pounds of aniline is astonishing. It is estimated that 1600 tons of coal will produce one ton of aniline. Three and a half million pounds or 1600 tons of aniline require therefore 2,500,000 tons of coal, which, in the first instance, would give 25,000,000,000 cubic feet of gas.

PURIFYING AND SEPARATING FATS.

A METHOD of separating the constituents of animal fat, suggested by Alfred Paraf and used by the Oleomargarine Manufacturing Company of New-York, consists in mincing the fat and introducing it, together with its own weight of water, into a wooden tank which is heated by a steam coil to from 100° to 120° F. and constantly stirred. After two hours, the oleomargarine and stearine separate from the scraps and are then allowed to cool, to separate from the water. They are then thoroughly worked with two per cent of salt, put in bags, and subjected to pressure or centrifugal action in a temperature of 60° F., which separates the oleomargarine from the stearine, as the latter is not affected by this heat, although the former is melted by it. After the oleomargarine has again congealed, it may be worked a second time with salt, to separate the last trace of water.

THE SPONTANEOUS IGNITION OF OILED COTTON OR SILK-WASTE.

MAJOR MAJENDIE has communicated to the Royal Artillery Institution the results of certain experiments, instituted to ascertain the relative degree of risk accompanying the presence of oiled cotton waste and oiled silk-waste in buildings and stores.

M. Galletly, who made the investigation referred to, read a paper at the Brighton meeting of the British Association for the Advancement of Science, on a series of experiments carried on by him, with a view of determining precisely the conditions under which spontaneous combustion takes place in cotton and other combustible material, when impregnated with animal or vegetable fatty oils. Mr. Galletly found that cotton-waste soaked in boiled linseed-oil and wrung out, if exposed to a temperature of 170°, set up oxidation so rapidly as to cause actual combustion in 105 minutes in the case where the action is slowest. The quantity in this instance was sufficient to fill a box 17 inches long by 17 inches broad, and 7 inches deep, but unfortunately it is by no means necessary that

the waste should exist in any such bulk, a common lucifer match-box full igniting in an hour in a chamber at 166° Fahr.

Raw linseed-oil ignited less rapidly. The experiment was made in a smaller case than the first one above mentioned. Active combustion took place in four or five hours. Rape-oil and Gallipoli olive-oil ignited somewhat less readily, taking at least five hours, though generally a good deal more. Rape-oil, in fact, took over six hours at 170°. The temperature of 130° was employed in the case of the Gallipoli-oil, and also in the following instances: Castor-oil took over a day before ignition; lard-oil took four hours; salad-oil, one hour and forty minutes; and sperm-oil refused to char the waste at all.

Mr. Galletly considers that the heavy oils from coal and shale tend remarkably to prevent the oxidation described, by protecting the tissue from contact with the air. It appears that the so-called spontaneous action of oiled cotton-waste proceeds from the substance being exposed in a finely divided condition to the oxidizing action of the air. In point of fact, it is the same action that causes the bloom in some of the direct processes for the reduction of iron to revert to the oxide when exposed in a heated state to the air, and the still more remarkable action that is said to have taken place in the iron removed from the Mary Rose, which had lain at the bottom of the sea till it became eaten into a porous condition. It appears to have been hoped that silk-waste might have offered greater security, but this proves not to be the case.

A NEW GALVANIC BATTERY.

ABBE FIEHOL, says *Les Mondes*, has recently constructed a new battery, using a Spanish mineral which is probably a kind of pyrites. Within a glass jar is placed a zinc cup, seven inches long, three inches deep, and two inches broad, into which the mineral is packed. Above is a piece of copper, and the interstices are filled with pulverized coke, mixed with ten per cent of chloride of sodium, (common salt,) and moistened with water. Four elements, united with isolated copper wires, copper to copper and zinc to zinc, it is stated, gave a current of surprising energy, fully equal to that of five Bunsen couples. The battery is constant, and it has been found that, after eighteen months' continuous use, it operates as well as when first employed. The only condition seems to be that it should be kept thoroughly moistened.

PROFESSOR JAMES DEWAR has made a series of experiments by which he has ascertained that the boiling-point of carbon is 18,032° Fah.

STEEL.

In the Mechanical Section, the opening address was delivered by W. H. Barlow, C.E., upon steel, relative to which he presented a large amount of useful information.

The tensile resistance varied in the different qualities of steel from twenty-eight to forty-eight tons per inch, and experiments established conclusively that the relation subsisting between the several resistances of tension, compression, and transverse strains is throughout practically the same as in wrought-iron; that is to say, that a bar of steel whose tensile strength is 50 per cent above that of wrought-iron will exhibit about the same relative increase of resistance under the other tests. They further showed that the limit of elasticity in steel is, like that of wrought-iron, rather more than half its ultimate resistance.

The series of experiments recorded in the book published by the committee gave the results of tempering steel in oil and water. They were made by the officers of the gun factory at the Royal Arsenal at Woolwich, and show a remarkable increase in strength obtained by this process. This property of steel is now fully recognized and made use of in the steel which forms the lining of the largest guns. The third series of experiments was made by the committee upon bars 14 feet long, 1¼ inches in diameter, with the skin upon the metal as it came from the rolls. The object of these experiments was specially directed to ascertain the modulus of elasticity. In these experiments sixty-seven steel bars were tested whose tensile strength varied from thirty-two to fifty-three tons per inch, and twenty-four iron bars varying from twenty-two to twenty-nine tons per inch.

These experiments, which were very accurately made, showed that the extension and compression of steel per ton per inch was a little less than wrought-iron, that the extension and compression were very nearly equal to each other, and that the modulus of elasticity of steel may be taken at 30,000,000, which result agrees with the conclusion arrived at by American engineers on this subject.

The fourth series of experiments was made by the committee on riveted steel, and show clearly that the same rules which apply to the riveting of iron apply equally to steel; that is to say, that the total shearing area of the rivets must be the same, or rather must not be less than the sectional area of the bar riveted. In applying steel to engineering structures, we may dismiss from consideration those superior qualities which are of high price and made in comparatively small quantities. I propose, therefore, to confine my observations to the mild steels, such as are

made by the "Bessemer," the "Siemens-Martin," and other processes, having a tensile strength varying from thirty-three to thirty-six tons per inch, a material which is made in large quantities and at moderate cost.

Following the same rule as is adopted for wrought-iron, namely, that the maximum strain on the metal shall not exceed one fourth of the breaking weight, we may consider steel of this quality capable of bearing at least eight tons per inch, instead of the five tons per inch estimated for like purposes in iron. We know from established mechanical laws that the limiting spans of structures vary directly as the strength of the material employed in their construction when the proportion of depth to span and all other circumstances remain the same. We know also that, taking an ordinary form of open wrought-iron detached girder, (as, for example, when the depth is one fourteenth of the span,) the limiting span in iron, with a strain of five tons to the inch upon the metal, is about 600 feet; and it follows that a steel girder of like proportions, capable of bearing eight tons to the inch, would have theoretically a limiting span of 960 feet. This theoretical limiting span of 960 feet would, however, be reduced by some practical considerations connected with the minimum thickness of metal employed in certain parts, and it would, in effect, become about 900 feet for a girder of the before-mentioned construction and proportions.

Assuming a load in addition to the weight of the girder of one ton to the foot, the relative weights under these conditions would be as follows:

Span.	Weight of steel girder. Tons.	Weight of iron girder. Tons.
200	57	100
300	150	300
400	320	800

It is not alone in the relative weight or in the relative cost that the advantage of the stronger material is important, but with steel we shall be enabled to cross openings which are absolutely impracticable in iron. Steel is used in the Illinois and St. Louis Bridge in America, a bridge of three arches, each of 500 feet span.

There is no doubt of the fact that steel is made and sold which is cold-short, and not reliable for use for engineering purposes. This irregularity appears to arise mainly from the difference in the chemical constituents of the metal or ores employed, or in the process pursued by different makers.

Where large castings and metal of great solidity are required, as in making large guns, there is the method pursued by Sir J. Whitworth, whereby the metal is intensely

compressed while in a fluid state. The pressure employed is twenty tons per inch, and its effect in producing solidification is such as to shorten the ingot about 1¼ inches for every foot of length. The treatment by compression is especially important where metal is required in large masses and of great ductility, because the larger the mass and the greater the ductility, the larger and more numerous are the air-cells, and the effect of the pressure is to completely close these cells and render the metal perfectly solid. By this process, mild steel can be made with a strength of forty tons to the inch, having a degree of ductility equal to that of the best iron. The more highly carbonized qualities, whose strengths range from forty-eight up to seventy-two tons per inch, show a decrease of ductility somewhat in the same ratio as the strength increases.

As to strength and toughness, there are small arms made entirely of steel, of wonderful range and accuracy, capable of penetrating thirty-four ¾-inch planks, which is about three times the penetrating power of the Enfield rifle. Secondly, there are the large guns, also entirely of steel, throwing projectiles from 250 lbs. to 310 lbs. in weight, and burning from 40 lbs. to 50 lbs. of powder at a charge, with which a range of nearly six and a half miles is obtained. In both cases, the degree of strength and toughness required in the metal is much greater than is necessary for engineering structures. It is unnecessary to occupy more time in multiplying examples of the toughness of steel. It is well known to manufacturers, and must also be well known to many others here present, that steel of the strength of thirty-three or thirty-six tons per inch can be made and is made in large quantities at moderate price, possessing all the toughness and malleability required in engineering structures.

ANNEALING STEEL.

G. W. BILLINGS, of Chicago, proposes the annealing of steel previous to working it, especially when only a portion of the article is desired to be softened—as, for instance, in punching a hole in plate or bar—by directing against the desired place a jet of steam of the proper temperature, by which the article is softened at that place, and a hole may be punched without straining the metal. He also suggests that wire, rods, etc., may be more evenly heated and annealed by being passed through a small open tube, which is surrounded by a cylinder filled with steam at the proper temperature, than is possible by the ordinary direct heat from a furnace which can not well be kept at the same degree at all times.

IMPROVEMENT IN CASTING STEEL.

IN the ordinary mode of casting steel in thick cast-iron moulds, it is rarely free from seams, soft places, honeycomb, etc., and to overcome this, William Dougherty, of Philadelphia, suggests casting the ingots in sheet-metal moulds or cases, of such thickness as will be brought to a welding heat without chilling the surface of the ingots, so that the case and steel will cool and shrink simultaneously and the two become thereby welded, preventing such imperfections as result from the shrinking of the ingot from the ordinary mould, which causes a loss of from ten to twenty-five per centum of the steel. During the process of reheating, a portion of the casing is burnt or wasted, and the remainder, being thin, is taken off, or nearly so with the working of the metal.

MANUFACTURE OF IRON AND STEEL.

MESSRS. BOLTON & PEDDEE, of Pittsburg, Pa., place the ore or oxide of iron which is to be worked into iron or steel, together with rather more than the theoretical amount of carbonaceous matter, into moulds or tubes, which are partially closed so as to protect the ore, etc., from the air, and subject the moulds or tubes to heat in a furnace until the ore is reduced, or partially so, when they are charged into the steel melting or puddling furnace, or passed under the hammer or between rollers, and made into blooms without the ore having come in contact with the air. In some cases, the moulds or tubes are covered with a coating of clay, or clay and plumbago.

IRON AND STEEL DIRECT FROM THE ORE.

MESSRS. PEDDER & ABEL, of Pittsburg, propose to manufacture iron and steel direct from the ore, by the introduction of carbonaceous gases into a case in which is inclosed the ore, in the form of metallic oxides. The case and its contents may then be, when properly tested, worked by the hammer or rolls into a bloom; or it may be placed directly into a bath of molten metal in any suitable furnace or crucible, be melted, and worked up into wrought-iron; or the case and its contents may be allowed to cool and be disposed of as an article of sale, like pig metal, or blooms.

HARDENING STEEL.

IT is stated by S. W. Etchell, of Weatherly, Pa., that steel may be made intensely hard without rendering it brittle by heating it until of a bright red, then rolling it in borax, or caustic alkali, and while still red-hot, plunging it into a bath of mercury. Some kinds of steel may require reheating and rolling in the borax or alkali, but in most cases it is not required.

NICKEL AND TUNGSTEN IN STEEL.

ACCORDING to H. A. Levallois, of Paris, a good quality of steel that may be hammered the same as ordinary steel, may be made by mixing from ninety-three to ninety-seven parts of soft iron with one half part of nickel, and from two and a half to six and a half parts of tungsten. The tungsten and nickel are mixed together with a flux of boric acid, silex, and carbonate of lime, inclosed in a sheet-iron tube and placed in the centre of the charge, said charge being sprinkled over with a quantity of the flux, varying from one half part to two parts of the latter, to one hundred parts of the charge. As soon as the mass has become liquid, it is run off in the usual way.

TUNGSTEN MIXTURE FOR STEEL.

Is is stated by Thomas Brooks, of Canton, O., that a steel which will be tough, malleable, easily welded without fluxes, and fitted for the finest tools and springs, may be made by smelting seventy-four pounds of Swedish bar-iron, fourteen ounces of tungsten, the same of spiegeleisen, eight ounces of charcoal, and one half ounce of manganese.

HARDENING STEEL BY AIR-CURRENTS.

ALFRED BENJAMIN, of Newark, N. J., suggests that steel wire or thin sheet steel may be conveniently and uniformly hardened by heating in the usual manner, and then passing it through a strong blast of air, which may be varied in strength according to the degree of hardness required.

WELDING STEEL TO CAST-IRON may be accomplished, according to J. H. Smith, of Madison Run Station, Va., by first shaping the steel so that it will correspond to the surface of the cast-iron to which it is to be welded without forming a lap, then heating to a cherry red, next applying borax to the surfaces to be united, and immediately heating the parts to a "borax" or welding heat, after which a strong pressure applied (without hammering) will securely join the steel to the iron.

MANUFACTURING SHEET-IRON.

ACCORDING to W. D. Wood, of McKeesport, Pa., sheet-iron having a polish superior to that of the best Russia sheet-iron may be made by first removing the scale by acid and alkaline baths in the usual way, then heating, and while still warm and free from oxide, the sheets are plunged into a bath of graphite and oil, after which they are rolled in packs of three or more at a good rolling heat, then trimmed, annealed, arranged in packs of from ten to one hundred, and while cold the packs are hammered over their entire surface.

TEMPERATURE OF MELTED IRON AND STEEL.

M. GRUENER, France, has been engaged in measuring the quantity of heat needful to effect the fusion of cast-iron slags, dross, and steel, in order to compare the heat produced in blast-furnaces with the heat utilized. He finds that cast-iron melts at from 2664° to 2874° Fahr. The heat of a hot-blast iron-furnace, for cast-iron, is ordinarily reckoned at 3002° Fahr. Bessemer steel, according to M. Grüner, melts at 2912° Fahr. Siemens estimates the heat necessary in a furnace to melt steel at 3000° Fahr.

THE MANUFACTURE OF IRON.

IRON is one of the most abundant of all the metals, but the difficulty of reducing the ore, for centuries prevented its coming into general use. Unlike copper and the precious metals, it is not found in a metallic state in nature except in meteoric masses which have fallen from the atmosphere. The ores of iron are mostly oxides. mixed with more or less silica and other impurities. They are readily distinguished by the streak, or mark made by rubbing on a piece of rough white porcelain. Magnetic or black oxide is a very rich ore, containing 70 per cent of iron. Its color is black and its streak black. It is attracted by the magnet like iron itself. It is plentiful in Orange and Putnam counties, New-York. Hematite ore is also an oxide containing nearly as much ore as the magnetic oxide. Its streak is blood-red, although its color is black: it is seldom magnetic. It is found in large quantities at Pilot Knob and Iron Mountain, Missouri. Limonite is a hydrated oxide of iron, which is also called bog ore, yellow ochre, brown ochre, and brown hematite. It has a brown color, and makes a yellowish-brown streak. Franklinite is an iron ore containing 16 or 17 per cent each of manganese and zinc. Its color is black; streak, dark reddish brown. It is found at Franklin, N. J., in large quantities. Being associated with other zinc ores, it has an association of red and black colors. Iron pyrites is a compound of sulphur and iron, found at St. Anthony's Nose on the Hudson river, and used for making oil of vitriol. Its color is brass-yellow; streak, greenish or brownish-black. Clay iron-stone, or spatic iron, is a carbonate of iron which is found at New-Milford, Ct., and at Sterling, Mass. It is white or grayish with a pearly or glassy lustre, and makes a white streak. It might be mistaken for dolomite or limestone, but is heavier. Specific gravity 3.8.

THE BLAST-FURNACE.

For the purpose of obtaining the metallic iron from the ore, a blast-furnace is employed. The figure accompany-

ing represents the section of such a furnace. They are usually 40 to 50 feet high, and 14 to 17 feet in diameter. It is cylindrical in form, diminishing in diameter toward the top and bottom. The narrow portion at the bottom is called the *crucible* or hearth, and is made of very refractory grit-stone. In the front of furnace (which is represented on the right of the figure) is an inclined piece of iron or stone, 8 or 10 inches high, known as the *tymp-iron*. Above this is an opening for the overflow of the slag. On both sides and behind (on the left of the figure) are openings for the *tuyeres* or blast-pipes. At the lowest part of the furnace is the *tap-hole*, for drawing off the melted metal at suitable intervals, and which, except at such times, is closed with sand and clay. Above the crucible the furnace suddenly widens, forming the boshes, and above this again comes the shaft.

The furnace is first heated with successive layers of fuel and ore. The burning fuel is converted into carbonic oxide and acid by the enormous quantity of air forced in through the tuyeres, which is not less than 6 tons, or 160,000 cubic feet per hour. Carbonic oxide is a powerful reducing agent, and this takes the oxygen from the ore and forms carbonic acid. The carbonic acid ascends, and in contact with the red-hot coal loses half its oxygen and becomes carbonic oxide, which in turn takes the oxygen from the next layer of ore, and so on.

These hot gases, on reaching the top, are no longer allowed to escape, as formerly, but are conducted off by large pipes, (one of which is seen on the left of the figure near the top,) to ovens in the adjacent building, where they serve to heat the air that is forced in through the tuyeres, (hot blast.) To permit of the furnace being charged at the top without allowing the gases to escape, an improved arrangement, called a "bell and hopper," is used, as seen in the figure. The ore and fuel are thrown into the

hopper and rest on a bell, until, by means of a lever, the bell is slightly lowered, and the materials are very evenly distributed over the whole surface of the furnace.

The use of the lime-stone or flux added is to unite with the silica, clay, and other impurities in the ore and form a readily fusible glass called "slag." As the metal is reduced and fused, it flows down into the crucible, while the melted slag, being lighter, floats on the top of the iron, and is drawn off at a higher level than the iron. The opening at the bottom of the furnace is closed by an iron plate called the dam, containing a coil through which cold water continually flows to prevent its burning up. The melted iron is drawn off twice a day, morning and evening, and is a grand sight to witness, especially at night.

Cast-iron, as it flows from the blast-furnace into the crude sand moulds, is quite impure, containing as much as 4 or 5 per cent of carbon. It also contains a little silicon, and sometimes phosphorus and sulphur. It fuses at a white heat, and can not be forged or welded. White cast-iron contains more carbon, is harder, more brittle, and more fusible than gray.

MALLEABLE OR BAR-IRON.

To convert cast-iron into malleable or bar-iron, its carbon and other impurities must be removed. These are burned out in a reverberatory or puddling-furnace. The details are nearly as follows: "The crude pig-iron is first remelted and suddenly cooled, by which it loses part of its carbon and silica, and is rendered white, crystalline, and exceedingly hard. In this state it is known as fine metal. It is next broken into fragments and introduced, in charges of 400 to 500 pounds, into a kind of reverberatory furnace, called a puddling-furnace, and again melted. The workmen then, by means of long iron bars, stir up (puddle) the fused mass, and thoroughly expose it to the influence of the heated air circulating above it. As the operation proceeds, the metal passes from a liquid to a pasty condition, emits blue flames, (carbonic oxide,) gradually grows tough and less plastic, and finally becomes pulverulent. At this point, the heat is raised to the highest intensity, and the air is carefully excluded by closing the furnace. When the metals soften sufficiently for the puddler to collect it in balls (called blooms,) upon the end of an iron bar, it is withdrawn from the furnace and placed under an immense steam-hammer, where the slag containing the impurities is hammered out. It is then rolled into bars.

Such is briefly and in popular terms the process of iron-making as practiced to-day. (69)

THE HENDERSON IRON PROCESS.

WE have heretofore chronicled the progress of this new improvement in the manufacture of iron, and are happy to be able to say that the recent tests to which it has been subjected, which have been many and thorough, have fully confirmed the great value and importance of the invention. It promises to revolutionize the art of manufacturing iron; greatly economizing in the labor and vastly improving the quality of the metal produced. The invention is by James Henderson, of New-York, who for the past year has been engaged in England, in developing the merits of the discovery, where it has attracted the greatest attention.

The Henderson process consists in the application of fluorine, in the form of fluor spar, and of oxygen in the form of oxide of iron to the molten cast-iron. The ingredients mentioned are thrown into the puddling-furnace and the cast-iron is then poured in upon the mixture, which remains at the bottom. The iron is then allowed to boil for about half an hour, then rabbled for ten minutes, when the metal is balled up. The time occupied is an hour for each charge. The fluorine and oxygen remove the phosphorus and other impurities within a few minutes. The discovery is applicable to the production of wrought-iron and steel of the best qualities. From cinder pig and the common brands of cast-iron, a wrought-iron having very great toughness is produced. Mr. Kirkaldy certifies that steel made from-the Henderson wrought-iron derived from common Scotch pig, gave a tensile strength equal to steel made from the best Swedish iron, and, in the form of tools, stood the wear equally well. The analyses of Dr. Noad show that the Henderson process removes every impurity from the iron. The *Mechanics' Magazine* states that, by the Henderson process, iron in England can be made equal in purity to the best Swedish, and substituted for Swedish in making the highest classes of steel.

NEW METHOD OF ASSAYING LEAD-ORES.

BY A. MASCAZZINI.—The method is based upon the conversion of the lead into sulphate by heating with ammonium sulphate. The author gives the preference to this salt over heated air, acids, hypochlorites, mercuric oxide, or fusion with nitre or amonium nitrate. Lead-ores which are all but free from other metals may be reduced directly by means of nascent hydrogen, (the zinc should be finely powdered,) and subsequent fusion into a button of lead. Ores containing blende or pyrites, however, are first converted into sulphates by means of am-

monium sulphate. The quantity of salt required varies with the percentage of metallic sulphides present. Two parts by weight of the dry sulphate usually suffice for the conversion of the richest ores into sulphates. The mixture of ore and ammonium salt is heated in a porcelain crucible covered with a small inverted dish. As soon as the boiling up has ceased, the temperature can be increased to strong red heat, without risk of losing any substance from spirting, till the ferric and cupric sulphates undergo decomposition. The mass when cold is readily dissolved out with hot water acidulated with a little sulphuric and hydrochloric acids. The latter prevents the silver from going into solution, especially if the liquid be diluted and allowed to stand for some time. The insoluble portion, consisting of lead sulphate and silver chloride, is removed by decantation and filtration, and is well washed with hot water, dried, removed to a flask, and treated with powdered zinc and hydrochloric acid as long as any reduction takes place. Two parts by weight of zinc are generally sufficient to reduce one part of pure galena, provided both the metallic zinc and lead sulphate be in the state of a fine powder and intimately mixed. Since even the best kinds of zinc contain a little lead, it is necessary to determine the amount of lead so present, and to make allowance for it. The spongy mass of reduced metals is washed with water freed from air, or with water acidulated with a little dilute sulphuric acid; it is next transferred to a flat basin and pressed with a flattened-out glass rod, and thoroughly washed. The mass is then introduced into a crucible, dried at a gentle heat, and mixed with 1½ to twice its weight of a reducing flux, covered with a thin layer of the same, or a little dry sodium chloride, and fused by raising the temperature gradually to red heat.

A flux proposed by Plattner, consisting of—

13	parts	by weight of	potassium carbonate,
10	"	"	dry sodium carbonate,
5	"	"	fused borax, and
5	"	"	dried starch,

effects the fusion readily, and yields a clean metallic button.

The same proces is applicable to the analysis of white-lead, minium, and litharge, of lead-ores containing gold and silver, and by somewhat modifying the fluxes, also to the estimation of antimony, tin, and copper. Should the gold or silver ores be deficient in lead, a quantity of litharge or lead-salt is added, sufficient to yield a proper regulus. (32, 36)

HARDENING LEAD.

LEAD which contains sulphur is so much harder than pure lead that galena or native sulphide of lead is often fused with the lead to give it hardness. A small quantity of antimony has the same effect. By combining the two processes and smelting together five parts by weight of lead to one part sulphuret of antimony, a bright hard regulus is obtained, which may be added to ordinary soft lead in suitable quantities to produce the desired hardness.

By fusing two parts galena and one part sulphide of antimony, sulphurous acid is given off, and a regulus of hard lead is obtained similar to the above, and consisting of sulphide of lead and antimoniureted lead. (69)

REDUCING SILVER SOLUTIONS WITH PHOSPHORUS.

THE silver residues of the photographer are readily precipitated by common salt or muriatic acid, and the chloride formed is sold as such, or reduced by zinc and sulphuric acid or in any other convenient manner. The chemist, however, has many other silver residues besides the nitrate and the haloid salts; and, in mixing all his waste silver compounds, curious chemical reactions take place in the waste-jar, so that the question of recovering the silver is far more complicated with the chemist than it is with the photographer. Many of these salts of silver are not decomposed by muriatic acid, but all are decomposed by phosphorus. The phosphorus is used in the form of phosphoric ether; a suitable amount is added and well shaken; a black precipitate at once separates, the liquid remaining more or less yellow or brown in color. If the precipitate contains little bright specks, the silver is not yet converted completely into the phosphide of silver, and more phosphoric ether is added until the precipitate acquires a uniform black color. It is then filtered, and the precipitate is washed and afterward boiled with caustic potash. The metallic silver is then at once obtained in a powder. If it is desirable to obtain the silver in a solid mass, it is done by fusing pure potash in a crucible and gradually dropping into the fused potash small portions of the dried precipitated phosphide of silver, which is thus both reduced and fused in the same operation, at a much lower heat than that required for melting silver, since the heat of an ordinary stove or furnace suffices for the process.

M. BOILLOT announces that, by causing the electric current to pass through a vessel containing a mixture of sulphur vapor and oxygen, he has determined the combination, and made the synthesis of sulphuric acid.

COMPARATIVE STRENGTH OF PHOSPHOR-BRONZE.

RECENT experiments to determine the strength, etc., of phosphor-bronze all tend to prove the remarkable properties that have been claimed for this alloy. The following data are from experiments made at the Imperial arsenal, at Vienna, by Col. Uchatius:

	Absolute resistance, lbs. per sq. inch.	Point of elasticity.	Elongation, per cent.
Phosphor-bronze.....	81,795	54,915	1.6
Krupp's cast-steel, as used for guns.....	72,258	14,450	11
Ordnance bronze.....	31,792	5,562	15

NEW-JERSEY spiegeleisen, often unfortunately called Franklinite, has been for some time produced from the residue of zinc ores after the ore has been treated for the extraction of the zinc; or, rather, for the conversion of the zinc into oxide. This residuum contains, besides 6 per cent of zinc, about 18 per cent of manganese and 40 per cent peroxide of iron, and is, as might be expected, an excellent material for the production of spiegeleisen. It has recently been discovered, by a clever Jerseyman, that if we add to this residuum any ore of iron, as hematite or magnetite, the yield of spiegeleisen is increased. The addition of a rich ore of iron could scarcely be expected to have any other effect than increasing the yield, and if the relative amount of manganese in the charge is not too greatly diminished by this addition, the product must still be spiegel. Strange to say, a patent has been granted for this wonderful discovery.

BISULPHIDE OF POTASH A REVEALING AGENT FOR GALENA.

M. JANNETTOZ, in *Les Mondes*, says that, on throwing a fragment or a crystal of bisulphate of potash, $\left.\begin{matrix}HO\\KO\end{matrix}\right\} 2SO_3$, on roughly-ground galena, a very sensible disengagement of sulphureted hydrogen ensues. If the two substances be ground together, the odor becomes almost insupportable. It is well known that sulphuric acid, mixed or even warmed with galena, does not give any sensible disengagement of sulphureted hydrogen, nor do the sulphurets of antimony, of iron, of mercury, of silver, or even those in which the lead and sulphur do not form an isolated combination, give such results with the bisulphate. But if, to any mixture whatever, a fragment of pure sulphuret of lead be added, at the moment when the rubbing or grinding of the whole with bisulphate of potash takes place, sulphydric acid is given off.

TUNGSTEN IN METALS.

FOR the last eight or ten years, tungsten has been used for improving the quality of puddled iron and steel, as well as cast-steel and cast-iron, in the manufacture of Mushet's "special steel," to toughen German silver, and for making alloys with gold, silver, lead, etc. In many instances, the use of this metal is kept secret. The commercial sources of the metal are enumerated as follows: A powder with 72 per cent of tungstic acid or 59 per cent of tungsten, purified for addition to steel costing four or five and a half thalers per hundred-weight; North-American ore with 74 to 76 per cent of tungstic acid, sometimes containing tin, of which the best varieties are used in the preparation of steel, bronze, and "mimargent" (100 parts of copper, 70 nickel, 5 tungsten, 1 aluminum); English ore with 80 per cent tungstic acid, contaminated with arsenic and copper, costing only three or four thalers per hundred-weight. Purer products come ground and washed from Cornwall, at five and a half to six and a half thalers; Redruth furnishes a product with a large amount of copper, costing twelve to fifteen thalers. From Limoges, in France, there is obtained a product, formed by heating the ore with tar and coal, containing 72 per cent of acid, at twelve to fifteen thalers. Bartels, in Hanover, furnishes a great number of preparations of tungsten for dyeing and printing. Tungstate of soda serves as a substitute for salts of tin, for rendering fabrics fireproof, for preparation of bronze, blue carmine, tungstic acid, ink, and for cosmetics, instead of white lead or white zinc. Tungsten steel retains magnetism longer than ordinary steel, and is therefore frequently used for telegraphic apparatus. (39)

DETECTION OF SMALL QUANTITIES OF TITANIUM.

FOR the detection of small quantities of titanium, Mr. Apjohn recommends to fuse 12 grammes of the finely pulverized mineral with six times its weight of acid sulphide of potash, until all of the free sulphuric acid is expelled. Pulverize the cold mass, exhaust with water, and boil the highly diluted aqueous solution in sulphite of soda. As soon as the precipitation is complete, allow the liquor to cool, and pass a little sulphurous acid through it to dissolve any small traces of iron or aluminum that may have been thrown down by the previous operations. The precipitate of titanic acid thus obtained can serve for the preparation of any of the salts of titanium. It is an interesting fact that titanic acid readily absorbs nitrogen, and upon this property Du Motay has founded a method of making ammonia directly from the air.

ANTIMONY AN EXPLOSIVE METAL.

If a piece of copper foil be attached to the negative pole of a galvanic battery, and a piece of platinum foil to the positive pole, and the two immersed in a hydrochloric acid solution of antimony, the antimony will be precipitated as a metallic mirror on the surface of the copper. After removing it from the liquid and carefully washing with distilled water, the brittle antimony can be removed by bending the copper back and forth. Antimony thus obtained will explode upon being rubbed in a mortar or struck with a hammer, light and heat as well as detonation being produced by the explosion. The reason of this extraordinary action of only one metal is due to the rapidity with which it returns from the amorphous form to the crystalline.

REDUCTION OF SILVER ORES.

Captain Selwyn, of the English navy, proposes the reduction of certain refractory silver ores containing a large percentage of lime, by boiling said ore for one hour in a solution of the following ingredients: Salt, one and a half parts by weight; hydrochloric acid, four and a half parts; manganese, one part; and water, two parts. After boiling, a clear metallic solution is obtained, which is then run into vats, and the metal precipitated in any well-known manner.

PROTECTION OF SMALL METALLIC ARTICLES.

It is stated by Cyrus D. Hunt, of Fair Haven, Mass., that small iron articles, such as tacks, nails, screws, etc., may be conveniently coated with tin, lead, or zinc, by putting them into a cylinder with a flux of resin and sal ammoniac, and a sufficient quantity of the metal with which it is desired to coat them, and rotating said cylinder over a fire until the metal is melted and the articles covered. The cylinder is then removed from the fire, the cover taken off, and the articles, by oscillations given to the cylinder, are thrown out, a few at each movement, and fall into water placed to receive them.

COMPOUND FOR FORGE FIRES.

A mixture consisting of two parts of borax, two and a half parts of muriate of ammonia, one part of nitrate of potash, and one fourth part of prussiate of iron is stated by Skinner & Goodson, of Callao, Mo., to be very useful when scattered over or put into the fire in which the iron or steel is to be heated, as it desulphurizes the coal, and iron or steel heated in such fire is freed from scales and corrosions, is refined, toughened, and softened. Cast-steel heated in a fire containing this compound, can, it is stated, be welded without any external application, and will bear a much higher heat without burning.

RECOVERING TIN FROM SCRAP.

A PROCESS for utilizing tin scrap, suggested by Henry Panton, of New-York, consists in first cutting it in a suitable machine into comparatively fine chips, and then placing it in a revolving cylinder so arranged as to constantly shower the chips with mercury with which the tin unites, and the two may be afterward separated by distillation, or by the oxidation of the tin.

VOLATILITY OF IRON.—It seems that iron is volatile at very high temperatures, the same as gold and platinum. Dr. Elsner, Director of the Berlin porcelain factory, inclosed a small piece of wrought-iron in an unglazed crucible and exposed it for several hours to a temperature of at least 3000° C. On removing the cover of the crucible, small needles of metallic iron were easily discerned, clearly showing that iron can be volatilized at high temperatures.

COMBUSTIBILITY OF THE DIAMOND.

AN experiment recently made by Mr. Spencer, of Manchester, seems to prove that under certain conditions the diamond is combustible at quite a low temperature. A South-African diamond, strongly colored and of about the size of a pea, was enveloped in refractory clay with a mixture of soda and hydrate of lime, placed in a crucible and then heated on the hearth of a muffle-furnace for three days and nights. Although during this period the temperature was not elevated above a cherry-red, it was found on opening the mass that the diamond had completely disappeared.

THE occurrence of indium (one of the rarest of the elements) in zinc blende, from several American localities, has been determined by Mr. H. B. Cornwall. From Roxbury, Ct., a blende was obtained so rich in indium that it could be detected spectroscopically by examining the raw powdered material without any preparatory chemical treatment. (39)

DETERMINATION OF MANGANESE IN CAST-IRONS AND STEELS.—One of the main causes of the loss of maganese in these determinations springs from the employment of too large an amount of acetate of soda in the previous precipitation of the iron. The author finds that in a perfectly neutral solution 1 grm. acetate of soda suffices to precipitate completely 1.1 grm. of iron in 500 c.c. of solution, and even in the presence of 1 grm. of acetic acid. When the determination of the manganese alone is required, he cools the liquid, makes up its volume to 500 c.c., filters through a dry filter, and determines the manganese in 250 c.c.—*Kiesser.*

REDUCTION OF AURIFEROUS PYRITES.

DR. IRA M. PHELPS has devised a process which is described as being of the highest metallurgical importance as well as scientific interest. The sulphur contained in the ore furnishes a large portion of the fuel; it being compelled, in a great measure, to consume itself. Oxygen and mercury, the former obtained from the atmosphere without money and without price, and the latter secured against excessive loss by properly constructed amalgamators, are the only chemicals needed, except that furnished by the ore itself. The sulphur which has hitherto been the most troublesome element, is made to do its duty not only in accomplishing its own destruction, but in effecting the release of the golden treasure it has so long and persistently guarded. That a thorough desulphurization of the ore is a necessary prelude to amalgamation is a conceded fact, and it is the difficulty of accomplishing this desulphurization that has led to so many failures. Dr. Phelps maintains that the cause of all the failures has been an insufficient supply of oxygen, the enormous bulk of air necessary to supply it never having been even approximately estimated or conceived. But in addition to this, there are four other conditions, to secure and maintain which is of vital importance: a supply of oxygen sufficient to meet all the demands of oxidation, a proper and timely regulation of the heat, the constant agitation of the ore, and sufficient time to perfect the chemical changes involved.

The importance of fine pulverization is fully recognized by Dr. Phelps, who takes especial care to point out the enormous difference, in the time required, which variation of size makes, a little variation in its superficies making a very great difference in the time required. Dr. Phelps claims to have obviated this difficulty by introducing the ore underneath the draught-current, and causing it to pass down the terrace floor of the inclined flue in a substratum of atmospheric eddies, without being once brought in contact with the ascending current.

NEW ALLOY FOR PLATING.

IT is stated by John Zimmer, of Cleveland, O., that a compound for the above purpose, that will give the effect and appearance of silver-plating, may be made by melting together fifty pounds of tin, three ounces of silver, twelve ounces of nickel, three ounces of bismuth, one half ounce of sulphur, two ounces of sal ammoniac, and one half ounce of mercury. This compound may be applied in the ordinary manner of tinning or zincing iron.

MONNIER'S PROCESS FOR COPPER.

THE sulphureted copper ores are roasted with soda, whereby, besides acid sodium sulphate, ferrous and cupric sulphates are formed. By stronger heating, the excess of acid in the sodium salt acts upon the metallic sulphides, and then follows decomposition of the ferrous sulphate. The copper salt, whose solubility is favored by the presence of the sodium salt, is washed out and the solution is evaporated to the crystallizing point. About four fifths of the sodium sulphate then crystallize out, and the mother liquors are further evaporated when cupric sulphate crystallizes with a little sodium sulphate. The cupric sulphate thus obtained is now dried and heated in a furnace with coal to a red heat, after which the sodium salt is washed out from the remaining cupric oxide and metallic copper. In this process, the iron for precipitating the copper is saved, and not more than 1 per cent of sodium salt is lost. From a pyrites containing 85 pounds per ton of copper, 82½ pounds of metal were actually obtained by this process. (36)

DIVISIBILITY OF METALS.

THE divisibility of quicksilver, and also of silver and gold, as shown by mining operations, is, says the Virginia City (Nev.) *Enterprise*, almost incomprehensibly great, and would seem to be almost illimitable, particularly in the case of the metal first named. A globule of quicksilver may be divided until no longer visible to the naked eye, and, indeed, until scarcely visible under a powerful microscope, yet even the most minute subdivision shall be found to contain silver or gold, perhaps both. How infinitesimally small, then, must be the particles of silver or gold contained in one of these invisible and immeasurable globules of mercury! In regard to the astonishing divisibility of the metal mentioned, we have learned some interesting facts of Dr. Buncher, Superintendent of the Rock Point Mill, Dayton. This gentleman informs us that some time since, when working in his mill for a considerable period an ore in which gold largely predominated, he used every precaution to guard against loss. In addition to the usual settling tanks, he caused to be dug in the ground a number of large pits, into which the waste water flowed after leaving the tanks. After leaving these pits, the water passed off in a small flume, and to the eye appeared as clear as the water of the purest mountain stream. For the sake of experiment, Mr. Buncher coated a copper bowl with quicksilver, and placed it in such a position that the water of the flume should fall into it. He also placed in

the flume, below the bowl, some copper riffles, properly coated with quicksilver. Although the water passing through the flume seemed to be perfectly clear, yet at the end of three months the bowl and riffles were cleaned up and over $100 worth of amalgam obtained. It appears to us that in these striking instances of the treacherous and unsuspected floating away of the precious metals, there is for mill-men food for reflection, and for inventors a field in which to reap both profit and distinction.

NEW COMPOUND OF BICHLORIDE OF MERCURY AND BROMIDE OF POTASSIUM.

IF to a solution of bromide of potassium be added an equivalent proportion of bichloride of mercury, in powder, the latter salt dissolves quite readily, and a solution is formed which, when evaporated, affords needle-shaped crystals, consisting, apparently, of a definite compound of the two salts; or it may be that an interchange of elements takes place, and that the new salt is composed of bromide of mercury and chloride of potassium. The solution deposits crystals of the same form even when evaporated to the last drop. These crystals are permanent in the air, and when just removed from the mother liquor are transparent, but, on drying, become white, with, a nacreous appearance. The salt dissolves readily in water. It gives, with iodide of potassium, a scarlet precipitate of biniodide of mercury; with nitrate of silver, a precipitate of bromide; with chlorine water, followed by chloroform, a solution of bromine in the latter liquid. (97)

DISINTEGRATION OF LEAD AND BISMUTH ALLOYS.

BY VOGEL.—Some casts of coins in the University cabinet were found to be greatly oxidized, and the metal in parts so rotten as to crumble between the fingers. The alloys were lead and bismuth, containing 34, 14, and 12 per cent of the latter metal. The oxidized portion contained much lead carbonate, and some bismuth oxide. The action of the atmosphere and the tendency of bismuth to assume a crystalline form are supposed to have occasioned the disintegration.

PREPARATION OF PLATINUM BLACK.

BY J. LAURENCE SMITH.—Reduce potassium platinum chloride by heating in a platinum crucible over a small Bunsen burner, hydrogen or coal-gas being led through a pipe passing through a small circular mica plate which covers the salt in the crucible. Wash the residue with water and dry it. (2)

PROFESSOR MAGNUS, of Berlin, demonstrates the combustibility of iron by the following beautiful experiment. One of the poles of a straight bar magnet is first sprinkled with iron filings, when the particles of course arrange themselves in accordance with the lines of magnetic force. The flame of a spirit-lamp or gas-burner is then applied, when the finely divided iron readily takes fire, and continues to burn brilliantly for a considerable time. By waving the magnet to and fro while combustion is going on, a beautiful rain of fire is produced.

IRON AND STEEL EXHIBITS OF THE WEST.

CONCEDING the greatness of the North-west as an agricultural and stock-raising region, people have been content to think that its progress is comprised in the products which its superiority in these respects so generally yields. The prospects of its great cities assuming an importance as manufacturing points has almost been lost sight of by the masses. The displays made by the iron-makers at the Chicago Exposition, says the New-York *Times*, show what these products are, and indicate to what extent the mining wealth of the West is being taken advantage of by points brought near to the ore regions by rail and lake navigation.

Among the exhibitors was the North-Chicago Rolling-Mills Company, of which Captain E. B. Ward is president. These mills have an annual capacity of 25,000 tons Bessemer steel rails, 30,000 tons railroad iron, and 50,000 tons pig metal. The samples which the company expose are very fine and extensive, and attract a large degree of attention. The texture of the metal used in them is illustrated by rails twisted, curled, bent double, and subjected to any process which will show the torsion, strength, and ductility of the metal. One of the most curious specimens is that of a polished steel rail about four feet in length, twisted while cold. The test thus given to the quality of the metal is severe, and certain to bring to light any of its imperfections. The rail in question shows not a fracture, flaw, or even the slightest blemish.

A number of broken steel ingots were also among the exhibition. They weigh from 1100 to 1400 pounds each, are perfectly solid, and show a texture and density that is not excelled by any Bessemer steel mill in this or any other country. The company claim that they are making as fine an ingot as is manufactured in the world. The quality of the Lake Superior iron is particularly adapted to the manufacture of steel, and it excels the best brands of the foreign market. The company are the owners of

vast mining interests in the Lake Superior regions, and they carry on the process of manufacturing through all the details, from mining the ore to turning out the rails. A piece which had been recently tested was on exhibition. It stood the remarkable test of 73,250 pounds to the square inch, with an elongation of sixteen per cent. A sample of chains manufactured of Bessemer steel, at the Wyandotte (Michigan) Rolling-Mills, constituted an interesting feature of the display. A comparative list of these chains with those of English make shows the following result:

Size.	Quality.	Strength.
1¼ inch	American	101,750
	English	76,500
⅞ inch	American	28,875
	English	19,000
¾ inch	American	38,000
	English	26,000
½ inch	American	15,825
	English	8,500
7-16 inch	American	10,250
	English	5,700

GALVANIC IRON.

By M. de Jacobi.—The solution submitted to electrolysis was prepared by dissolving 135 parts of ferrous sulphate, and 123 parts of magnesium sulphate in water, and diluting the liquor to the density 1.27. A Smee's couple furnished the electrolytic current, and the iron was deposited in the form of a tube upon a wax cathode 34 centimeters long and 2 cm. in diameter, the wax having previously received a very thin coating of electro-deposited copper.

After twenty-eight days' action, the deposited iron was examined. The wax having been melted out, the copper was dissolved by a solution of potassium cyanide aided by a weak electric current.

The appearance of the two deposits was somewhat different. No. II. was fairly smooth and regular. No. I. was smooth toward the centre, but at the upper and lower extremities it was characterized by large excrescential growths, which in some places assumed a dendritic or ramose structure. The specimens possessed a feeble, but only a feeble permanent magnetism.

Electro-deposited iron is naturally hard and brittle, but if it be heated to redness and slowly cooled, it acquires the properties of soft iron, and becomes malleable and ductile. It may be converted into steel by a process analogous to cementation, which communicates to it the hardness of glass; but by continually heating and cooling a specimen thus hardened, it is brought back to the condition of soft iron.

A tube of galvanic iron is capable of acquiring an in-

tense temporary magnetism, equal to that which can be communicated, under the same conditions, to a solid cylinder of soft iron of the same dimensions; but this magnetism disappears instantly when the magnetizing action ceases, without leaving behind any residual traces, no matter in what manner the magnetic influence was excited.

An induction coil fitted with a galvanic tube will determine physiological commotions notably more intense than those which can be induced by means of a massive cylinder or of a tube of the same dimensions as the galvanic tube; and it was observed as a fact resulting uniformly from many experiments that, if the wires constituting the central core of an ordinary induction coil be diminished in number, so as to render the shocks comparable with those produced by the galvanic tube, there is a sensible equality between the weights of the wire and of the tube. (32)

INFLUENCE OF ACIDS ON IRON AND STEEL.

By W. Johnson.—Pieces of iron and steel wire, on immersion in hydrochloric or sulphuric acid, washing in water, and drying, were found to have gained in weight. This gain varied from 0.0005 to 0.06 per cent, being greater with iron than with steel, and with sulphuric than with hydrochloric acid. (The first of the above numbers appears very small, but the author would seem to be in possession of extraordinary accurate weighing apparatus, since he gives weights of over 80 grammes to the $\frac{1}{100}$ milligramme. He moreover calculates all percentages to the sixth decimal.) The breaking strain of iron wire was diminished by immersion in hydrochloric acid from 0.5 to 3 per cent, and in the case of steel wire, 4.67 per cent. The elongation of iron wire was but little affected by the same treatment, but the elongation of steel was increased about 30 per cent. The toughness of both was diminished, that of steel in a very marked way, a coil of steel, after immersion, breaking if allowed to fall on the ground, and even flying in pieces directly it was placed in the acid. When iron and steel wire which had been immersed were heated in a confined space, the surface became rusted, sometimes uniformly, sometimes in spots. This did not take place if the air had free access. The spotted rust forms in some cases without heating, by mere lapse of time. When the wire, after immersion in acid, washing and drying, coating with lime, and drawing out finer to remove every trace of acid from the surface, is broken, and the fracture is moistened, bubbles of gas rise over the whole surface of the fracture. The water does not, however, alter litmus-paper. By exposure to air,

washing with water, or gentle heating, all the above effects of acid upon iron or steel decrease in intensity and finally cease, leaving the metal in its original state. Pyroligneous acid acts in a similar way to the two acids mentioned. Zinc appears to have a power similar to that of acid in rendering iron brittle. A piece of galvanized iron which could be bent to and fro several times without breaking was rapidly raised to a red heat, so that all the zinc should not be volatilized. On trying to bend it, it broke off short, although when all the zinc was volatilized it could not be broken by bending. (2)

GILDING IRON BY THE DRY PROCESS.

By W. Kirchman.—Sodium amalgam was found an advantageous means of simplifying the method of dry-gilding iron, and for painting gold designs thereon. By simply rubbing with this amalgam, the surfaces of iron and similar metals, although oxidized, are immediately amalgamated. Gold chloride in concentrated solution is then applied qnickly on the amalgamated surface, and the mercury volatilized by the heat of lamp or fire. A very uniform gilding is thus obtained, admitting of high polish. With silver and platinum-salts, corresponding results are obtained.

PETROLEUM STEEL.

It is stated by J. G. Blunt, of Leavenworth, Kan., that steel may be made from pig or cast-iron, by heating, melting, boiling, and puddling in the usual manner, and after being puddled sufficiently to decarbonize it and remove the impurities, the air-blast is turned off from the furnace, and sufficient petroleum vapor or gas is admitted into the oven to prevent the admission of air. Petroleum vapor is now forced into and through the mass of molten metal in a series of small jets, and by this direct introduction of hydrocarbon the metal can be carbonized to make any grade of steel desired, after which the mass is balled and treated in the usual manner with the squeezers, or hammers and rolls.

MUSHET'S STEEL.

This steel, manufactured by the "Titanic Forest Steel Works Company," is so hard that ordinary steel may be cut with it; it can be worked at a low red heat; if plunged into water while hot it breaks into small pieces; it may, however, be tempered by slow cooling in an oil-bath.

This steel, according to the author, contains no titanium, but about 8 per cent of tungsten, associated with .014 per cent carbon, and .0024 per cent silicon. A full analysis is not given.

NEW PROCESS FOR STEEL.

By Bajault and Roche.—A mixture of powdered ore and molten cast-iron is cast in moulds made of metal; the ingots thus made, of which the moulds form part, are then heated in a peculiar furnace to a bright red heat for some time; carbon oxide is evolved and ingots of crude steel are formed; these only require melting in crucibles or a reverberatory furnace to be fit for use. The action of the ore upon the walls of the furnace is thus avoided, and thus the principal objection to the use of rich ores is got rid of.

All degrees of carburation may be obtained by this process, the proportions of cast-iron and oxide being determinable with almost mathematical precision. (4)

DIAMOND HARDNESS IN STEEL.

By J. Schuszleder.—Watch and clock-makers and engravers harden their steel in sealing-wax. The article is made white-hot and thrust into sealing-wax, allowed to remain a second, then withdrawn, and again inserted in another part, and this treatment is continued till the steel is cold and will no more enter the wax. The hardness thus obtained is extreme, and comparable to that of the diamond; in fact, steel hardened by other processes may be engraved or bored with it, the engraving or boring tool being previously moistened with oil of turpentine. (36)

ARSENIC IN SULPHURIC ACID.

Iron and copper pyrites (compounds of sulphur with the metal) are now extensively employed as sources of sulphur in the manufacture of sulphuric acid, and both these substances always or nearly always contain a notable quantity of arsenic. In order to separate the sulphur from the metal and convert it into sulphurous acid, the ore is roasted in suitable kilns and the gaseous and volatile products carried over, by means of a flue, into the leaden chamber where in the presence of other substances the formation of sulphuric acid is completed. But arsenic, like sulphur, is set free from the ore by the action of heat, and passes over along with the latter into the leaden chamber.

Arsenic is not only the most deleterious but the most difficult to remove of all the impurities of sulphuric acid. For medicinal purposes, therefore, and for use in certain medico-legal examinations, where perfect purity is required, an acid is employed made from pure sulphur, and even this has to be purified before it is fit for use. But in alkali manufacture, where immense quantities of the acid are consumed, that derived from pyrites is usually employed without previous purification, the products of the

industry, such as hydrochloric acid, carbonate of soda, and sulphate of soda, being subsequently cleansed, when that is thought necessary. A recent writer on the subject, of much experience, Mr. H. A. Smith, strongly condemns this practice of first using an impure acid and then hunting up and removing the impurity after it has been distributed through a variety of products. "If the arsenic is to be removed at all," says Mr. Smith, "every thing points to the sulphuric acid stage as that in which the removal ought to take place. Sulphuric acid is the cornerstone of alkali manufacture; cleanse it, and the whole is clean."

PHENOLCYANINE.

By T. L. Phipson.—Phenol dissolved in alcoholic ammonia and exposed to the air for many weeks, furnishes a deep-blue resinous substance, which in the dry state has a coppery lustre like that of indigo.

It melts easily and may be partly volatilized in purple vapors. It is soluble in alcohol, ether, and benzine, also in concentrated sulphuric acid. Nitric acid decomposes it, forming a nitro-derivative quite different from picric acid.

Phenolcyanine is very slightly soluble in pure water, but dissolves in alcohol diluted with aqueous ammonia. These solutions are deep blue by daylight. Acids redden them, the blue color being restored by alkalies.

The solutions of phenolcyanine are completely decolorised by nascent hydrogen developed from zinc and an acid, but not by a mixture of ferrous sulphate and lime.

The author's analyses of this body have not been very satisfactory, but he believes it to be represented by the formula C_6H_3NO, and to have some relation to orcein and to indigo-blue.—*Compt. rend.*, lxxvi. 1417.

BENZINE-POTASSIUM, A NEW EXPLOSIVE.

By H. Abeljanz.—When benzine and potassium are heated together in a sealed tube to 240°–250°, they combine and form *benzine-potassium*. It is a black mass which appears blue when viewed in thin layers. In the dry state it is very explosive, and it is decomposed violently by water. The gradual action of water on it gives rise to diphenyl.

INFLUENCE OF METALLIC SALTS ON VEGETATION.

Jules Raulin gives the results of some experiments on the action of salts on the growth of fungi. The following is the composition of the solution most favorable to the growth of aspergillus: water, 1500 grammes; sugar, 70; tartaric acid, 4; ammonium nitrate, 4; ammonium phos-

phate, 0.6; potassium carbonate, 0.6; magnesium carbonate, 0.4; ammonium sulphate, 0.25; zinc sulphate, 0.07; ferric sulphate, 0.07; potassium silicate, 0.07. The action of zinc salts is remarkable: the presence of $\frac{1}{50,000}$ of zinc sulphate in the solution produces a crop three or four times as great as in the absence of zinc. Want of iron salts is little detrimental to the growth of the mould, but the addition of $\frac{1}{100,000}$ of silver nitrate, or $\frac{1}{300,000}$ of mercuric chloride to the solution is sufficient to prevent any further development.

RANSOME'S NEW ARTIFICIAL STONE.

THE following mixtures give three qualities of a very hard and durable cement, capable of resisting the action of the weather. It is very suitable for cementing fractures in marble or stone images, monuments, or ornamental work, which are exposed in the open air.

	No. 1.	No. 2.	No. 3.
Portland cement.....	12 parts.	6 parts.	9 parts.
Chalk paste.....	6 "	12 "	6 "
Fine sand.....	6 "	6 "	6 "
Silicious earth.....	1 "	1 "	1 "

The above mixtures were made into a thick paste with soda water-glass. No. 2 gave the hardest cement, and No. 3 the coarsest grain.

NOVEL PHOSPHORESCENT SUBSTANCES.

BY G. SEELHORST.—The author has prepared a number of substances which exhibit phosphorescence.

1. *Green Phosphorescent.*—Strontium thiosulphate is heated for fifteen minutes over the Bunsen lamp, and for five minutes over the blowpipe.

2. *Blue Phosphorescent.*—Strontium sulphate was mixed with a sulphate of unknown composition, (prepared by decomposing strontium chloride,) and the mixture reduced with hydrogen, and heated.

A number of other substances are enumerated. The author states that if these substances are mixed with melted paraffine and the mixture painted on to glass plates, imitations of flowers, etc., may be produced, which when placed against a black background and illuminated with magnesium light, appear very beautiful. (32–36)

A FEW years since, it was seriously considered whether it would not pay to reduce to powder a new prison in Melbourne, built of auriferous quartz, and erect another. Recently we heard of the streets of Maryborough, Victoria, being so resplendent with gold that their very sweepings are more valuable than the labor bestowed upon their collection and washing.

PHOSPHORIC ACID.

THE occurrence of phosphorus in combination with the ores of iron has long been an annoyance to iron manufacturers, and many rich ores are worthless from the presence of phosphorus, which makes the iron brittle and useless. Julius Jacobi proposes a method of freeing iron ores from phosphorus, and at the same time saving the phosphoric products for agricultural purposes. His process consists in roasting the ore and crushing it, and, after placing it in a proper receiver, submitting it to the action of water charged with sulphurous acid under pressure. The ore is then washed with water, to remove all the soluble products, and the phosphoric acid, precipitated from the water with fresh-burnt lime, is obtained as a neutral phosphate of lime. If effectual and not too expensive, the proposed method is very important, as rendering many ores available which are now regarded as worthless, and at the same time supplying a demand in agriculture which has heretofore been but imperfectly met.

THE ATTRACTIONS OF SOLIDS, LIQUIDS, AND GASES.

BY C. F. HENRICI.—When solid bodies are brought in contact with liquids which contain gases in solution, three cases may be distinguished: (1) The attraction between liquid and gas is predominant; in this case no essential change will be effected by the immersion of a solid body; (2) The attraction between the solid and the gas predominates; then the gas is condensed on the surface, but not eliminated in the form of bubbles; (3) The attraction between the solid and the liquid predominates; then the liquid is condensed on the solid surface, and the gas is eliminated.

The author's experiments refer to the third case. Clean surfaces prepared by rubbing pieces of metal, bone, or glass between leather strewed over with pumice-stone powder, were immersed in ordinary well-water or in water supersaturated with carbonic acid by addition of a small quantity of Seidlitz powder. In both cases the surfaces became completely covered with gas-bubbles. Surfaces which have been heated in a flame do not exhibit this phenomenon, probably because they become covered with a carbonaceous film, which prevents the formation of bubbles by absorbing the gas which is eliminated by the condensation of the liquid. The existence of some film on surfaces which have been in a flame may be inferred from a certain very slight resistance which is felt when they are drawn through a soft linen cloth.

Liquids containing very little gas exhibit the above phenomena in a very distinct manner on being placed in a glass vessel upon a heated plate, evidently because the affinity between gas and liquid is weakened by increase of temperature.

The experiments with leaves which are covered with extremely fine hairs prove that projecting points or a very slight roughness favor the separation of the bubbles. A bubble once being formed, air from the surrounding liquid enters into it in the same manner as it passes from the surface of the liquid into the atmosphere. The bubbles are not in contact with the surface; they do not unite with each other, and they do not attain the same size on glass as on metals. Gas-bubbles seem to be formed whatever may be the cause of the condensation of the liquid; by bringing a drop of some saline solution or of potash upon the surface of water, bubbles are evolved as the saline liquid sinks to the bottom.

The sudden appearance of bubbles on striking a glass of champagne is probably also due to a temporary condensation of the liquid.

Some experiments are mentioned referring to the case in which the affinity between the solid body and the absorbed gas is greater than that between the gas and the liquid. Previously ignited pieces of powder of charcoal and of graphite were immersed in water richly charged with carbonic acid; but no gas-bubbles were observed, because the gas, instead of being eliminated, was condensed and absorbed on the solid surface.

When silver or platinum wire was immersed in strong ammonia solution, increase of temperature was necessary for the separation of gas-bubbles. This experiment illustrates the first case in which the affinity between gas and liquid is predominant.

No gas-bubbles were observed on the surface of fats and oils in contact with water which was saturated with carbonic acid. (88, 32)

ODOROUS AND LIQUEFIABLE GASES.

A WRITER in the *Pharmaceutical Journal* notes a remarkable relation between the odor of gases and their reducibility to the liquid or solid state. Thus oxygen, hydrogen, and nitrogen, which have no odor, can not be reduced either by pressure or by cold. On the other hand, chlorine, which has a very strong odor, is easily condensed to a liquid. Again the protoxide of carbon, being odorless, can not be condensed, while the dioxide or carbonic acid, which has a faint, pleasant, and pungent

odor, can be reduced to a liquid, and even to a solid state. Nitrous and nitric oxide, the latter of which is odorless, show similar phenomena. An exception to the general rule, that gases which are odorous are condensible, is furnished by acetylene, which, though having a faint garlic smell, has never been condensed. Usually condensibility stands in a direct ratio to the strength of the odor possessed by a gas. Thus, sulphurous acid, which has a most intense odor, becomes a liquid under a pressure of two atmospheres, at 15° Fahr., while nitrous oxide, which has but a faint smell, requires fifty atmospheres, and a temperature of 7.2° Fahr. A few gases having a fetid odor are exceptions to this law, but it holds good so generally, that a list of gases, arranged according to their reducibility, and another list arranged according to their properties of smell, will show a rough though marked coincidence.

PRODUCTION OF FURFUROL.

By C. Greville Williams.—When fir-wood is heated with water in a closed vessel, and a pressure of 100 lbs. to the inch maintained for a considerable time, an acid liquor is obtained, from which, by repeated rectification, two principal products may be separated. These are methylic alcohol and an oil, (furfurol,) the yield of the latter from 100 lbs. of wood being 10 ounces.

A mean of four experiments showed that 100 parts of crude oil gave 39.3 of furfuramide, corresponding to 42.3 per cent of furfurol. Hugo Müller corroborates the foregoing results. Having operated in a similar series of experiments with bamboo-wood, he obtained an appreciable quantity of a heavy oily liquid, which exhibited all the properties of furfurol, and produced, on the addition of ammonia, the well-characterized furfuramide. Müller does not think that the production of furfurol is due to the action of the organic acids which are simultaneously or previously formed; at the same time he mentions that when the wood is treated with caustic soda-lye instead of water, the formation of furfurol does not appear to take place.

Furfurol may also be obtained by the action of high-pressure steam upon wood. The apparatus used consists of a vessel capable of withstanding a pressure of 500 lbs. to the square inch, within which is placed a cylinder of perforated metal filled with sawdust and standing on a perforated shelf; the bottom of the vessel is covered with a layer of water not reaching to the shelf. The vessel having been tightly closed, is heated in an oil-bath to 198° C. for three or four hours, after which it is left to cool till the

pressure has completely gone down. It is then opened and connected with a condenser, and heated till about three fourths of the water present has distilled over. The watery distillate thus obtained smells strongly of furfurol, and when mixed with ammonia, yields crystals of furfuramide.

It appears, then, that furfurol may be produced from wood by the action either of water or of steam at high temperatures and pressures. The author finds, however, that it is not produced by distilling sawdust with water under the ordinary pressure. (4)

PHENANTHRENE, A NEW HYDROCARBON FROM COAL-TAR.

By R. Fittig and E. Ostermayer.—*Phenanthrene*, $C_{14}H_{10}$, an isomeride of anthracene, was found in a neutral coal-tar oil boiling between 300°–400°. It was isolated by subjecting the oil to fractional distillation and cooling the portions boiling above 300° to 0°. The crystals were dried on blotting-paper and repeatedly crystallized from alcohol, to remove anthracene and other bodies. Phenanthrene is sparingly soluble in cold alcohol, but dissolves readily in hot alcohol, ether, benzine, acetic acid, and carbon sulphide. It crystallizes in small plates, which in the pure state are brilliant and colorless, but generally have a yellowish color. It melts at 99°–100°, and very readily sublimes, but boils only at a temperature much above 300°. On mixing cold saturated solutions of the hydrocarbon and picric acid, the compound, $C_{14}H_{10} + C_6H_2(NO_2)_3OH$, separates after some time in red needles melting at 143°. When bromine is added, drop by drop, to an ethereal solution of phenanthrene, the additive compound, $C_{14}H_{10}Br_2$, is formed, crystallizing in four-sided prisms. It is a very unstable body, decomposing spontaneously on keeping. (32)

KARAKINE.

By W. Skey.—The nut of the Karaka tree is poisonous in its natural state, but yet it is one of the staple vegetable articles of food of the natives of New-Zealand. After being gathered, the nuts are partially baked in earth-ovens, and then washed for some time in a stream of water. The poisonous matter is thus removed, and the nuts are then dried and stored for use.

The author has isolated the bitter substance thus removed by the natives, in the form of beautifully radiating acicular crystals. It possesses more the character and properties of a glucoside than of an alkaloid, and it is proposed to call it *karakine*.

NEW MODE OF PRODUCING OZONE.

BY A. BOILLOT.—A tube 0.45 metre in length, and 10 mm. interior diameter, is placed within another tube, 0.40 metre in length, and 15 mm. interior diameter. The annular space between the two tubes is filled with finely powdered gas-carbon. The inner tube contains the same kind of carbon in small pieces. Through the inner tube is passed a stream of dry oxygen, a current of induced electricity, derived from a Ruhmkorff coil, working with five Bunsen's elements, being at the same time sent through the apparatus. The mean of two experiments gave 0.0435 gramme of ozone per litre of oxygen. (4)

OZONE BY THE SILENT ELECTRIC DISCHARGE.

BY A. BOILLOT.—The apparatus employed, by which ozone may readily be produced, consists of a closed glass tube filled with powdered animal charcoal, and having a platinum wire sealed into it. This is placed in the axis of two other concentric glass tubes, the space between these outer tubes being also filled with charcoal and furnished with a platinum wire. When these wires are attached to the terminals of an induction coil in action, the silent discharge passes between the two surfaces and oxygen is rapidly converted into ozone by its means. The vapor of sulphur in contact with oxygen was found to yield sulphurous acid accompanied by a little sulphuric acid; when the discharge passed, much sulphuric acid was produced. Again, hydrogen and the vapor of sulphur do not act upon one another, but with the discharge sulphydric acid is immediately formed. (4)

ANTHRACENAMINE.

BY T. L. PHIPSON.—This new base may be obtained by adding anthracene in powder, in small quantities at a time, to ordinary nitric acid contained in a capsule which can be cooled if necessary. A soft reddish-brown mass is obtained which melts easily, and can be drawn out into long golden-yellow filaments. This product contains a certain quantity of mononitranthracene, $C_{14}H_9NO_2$, soluble in alcohol, from which it crystallizes in small yellow needles. If the temperature is allowed to rise and the acid boils, several other products are obtained and much oxanthracene. The product is washed and placed in a flask with tin and hydrochloric acid, diluted with its own volume of water and boiled quietly for an hour, then filtered. The filtered liquid contains chloride of anthracenamine and tin chloride; the base is extracted by excess of potash, which dissolves the tin oxide and leaves the anthracena-

mine. It is necessary to repeat the operation twice to get rid of all the tin.

Anthracenamine is a pale yellow powder, forming soluble and crystallizable salts with sulphuric and hydrochloric acids. It is very soluble in alcohol, but slightly soluble in water; its odor is very slight, and its taste is hot, pungent, and persistent, very like that of the unknown substance which exists in the arum maculatum. Its acid salts produce with potassium bichromate a characteristic emerald-green color, and finally precipitate a powder of this color which is soluble in alcohol. This solution presents no marked peculiarity when viewed in the spectroscope. The reaction is as characteristic of anthracenamine as the blue color produced in similar circumstances is of naphthylamine. It is not obtained, however, with lead peroxide or with calcium hypochlorite, but it is obtained with concentrated nitric acid.

Anthracenamine is easily decomposed; and from the percentage of nitrogen it contains, the author concludes that its composition may be represented by the formula, $C_{14}H_{11}N$. (2)

RUBIDIUM FROM BEET-ROOT ASH.

By C. Pfeiffer.—The mother-liquor left in preparing saltpetre from the ash of beet-root molasses is mixed with saw-dust and deflagrated, the charred mass exhausted with water, the solution evaporated to 1.317 s. g., and the sulphates and chlorides allowed to crystallize out. This second mother-liquor is mixed with hydrochloric acid, heated, filtered from precipitated sulphur, etc., and boiled with nitric acid till all iodine and bromine are expelled. The rubidium is now precipitated from the diluted solution by platinum tetrachloride, and separated as usual.

Direct experiment shows that one kilogramme of the beet-ash of Northern France contains 1.75 grm. of rubidium chloride, and that the rubidium coloride is to the sodium chloride and potassium chloride as 1 : 126 and 331. (36)

ACTION OF ETHER UPON IODIDES.

By E. Ferriere.—When a concentrated solution of an iodide is mixed with starch-paste and then shaken with ether, part of the iodine is separated, and the starch is turned blue. If the solution is dilute, the bluing does not appear till after two or three hours, and in extremely dilute solutions, not till after two or three days. On filtering from the blue starch and adding more ether, a blue color is again produced, and so on, till at length all the iodine is removed from the compound. Mineral waters containing iodides exhibit, when thus treated, the same reactions as artificially prepared solutions.

PRODUCTION OF VEGETABLE TISSUE.

IT has been ascertained by Professor E. N. Horsford that an ethereal extract of green leaves, which has been separated by hydrogen chloride into two layers, a yellow and a blue layer, contains in both portions phosphoric acid, iron, potassium, and calcium. He has further observed that a mixture of sodium phosphate and iron protosulphate in presence of water is able both in light and darkness to reduce carbonic acid to carbonic oxide. From these observations, it appears probable that the formation of a solution of a phosphate of iron protoxide may be a preliminary stage toward the production of vegetable tissue from the elements of carbonic acid, water, and ammonia. Formic acid, it is well known, may be formed by the direct combination of carbonic oxide and water.

NEW ORGANIC COMPOUNDS.

BY F. PFANKUCH.—*Cyanoform and Methintricarbonic Acid.*—Traces only of cyanoform are obtained by Fairley's method; the main product consists of a brown, tarry mass. Small quantities of cyanoform are formed by heating chloroform with silver cyanide. By carefully regulating the temperature (120°–130°) and the amount of alcohol added to the mixture of chloroform and potassium cyanide, the author has been able to obtain a certain quantity of pure cyanoform; it crystallizes from an alcoholic solution on slow evaporation in small, yellowish-white needles, which can scarcely be said to possess a pleasant odor. Cyanoform is readily converted into *methintricarbonic acid* by heating either with soda or with hydrochloric acid solution. This acid crystallizes in small needles; an analysis of it, agreeing well with the formula, $CH(CO_2H)_3$, is quoted. The normal sodium salt $CH(CO_2Na)_3$ is precipitated on the addition of soda solution to a not too weak aqueous solution of the acid; it forms most brilliantly glistening plates. This also was analyzed. The barium salt is finely crystalline, and almost insoluble in water. The silver salt, $CH(CO_2Ag)_3$, is non-crystalline; a silver determination gave 69.1; the formula requires 69.0.

Sulphoform.—Chloroform acts with explosive violence on an alcoholic solution of potassium sulphide; and alcohol extracts from the product a double compound of sulphoform and potassium sulphide, crystallizing in long prisms.

New Modes of forming Hydrocarbons.—In describing the production of diphenyl by distillation of a mixture of potassium phenate and benzoate, the author notes that the yield, which is not small, depends on the dryness of the

salts employed, and more especially on the proportion in which they are taken ; it is desirable to employ a considerable excess over the equivalent quantity of benzoate, although less than double the amount theoretically required should be taken, otherwise the formation of benzophenone interferes with the purification of the product.

The dry distillation of a mixture of potassium phenate and valerate yielded isobutylbenzine (boiling-point, 160°.) A mixture of potassium chlorobenzoate and phenate gave monochlorodiphenyl, $C_{12}H_9Cl$, (melting-point, 89°.) Similarly a mixture of potassium acetate and tribromophenate gave tribromotoluene, $C_7H_5Br_3$, which crystallizes from alcohol in small white needles, melting at 150°.

New Modes of Action of Sulphur.—The author states that the yield of tolane, $C_{14}H_{10}$, on distilling sulphur with barium benzoate, is at least 90 per cent of that indicated by theory. He enters at length into a description of the mode of purifying the crude product, which contains much tolane sulphide, by copper reduced from the oxide. By distilling a mixture of barium acetate and sulphur, and subsequently removing the sulphur from the product by copper or lead, a liquid hydrocarbon of the composition C_4H_6 (divinyl) was obtained ; it is a light oil, which is characterized by an exceedingly sharp, persistent, but not unpleasant odor ; the product analyzed boiled at about 20°.

These results led the author to examine the action of the metallic sulphocyanates on the metallic salts of acids, such as benzoic, acetic, etc., in the hope of obtaining organic cyanides. By dry distillation of a mixture of barium benzoate with sulphocyanate in excess, a partially solid distillate was obtained, consisting of benzonitrile, tolane, and new hydrocarbon cyanide ; the latter proved to be a mixture of a liquid and a solid compound, neither of which could be obtained in a state of purity. From the still impure liquid compound an acid was obtained by treatment with potash solution, etc., which gave on analysis numbers agreeing with the formula, $C_6H_5.C.CO_2H$. This acid the author terms *benzacrylic acid.* It crystallizes in small glistening needles which melt at 101° ; it is a far stronger acid then benzoic, though less stable.

The acid formed by similarly treating the solid cyano-product could not be prepared perfectly pure ; it appears, however, to be identical with an acid formed on heating the product of the action of cyanogen on an alcoholic solution of tolane with potash. Both the liquid and the solid cyano-compounds appear to be formed by passing tolane vapor over heated mercury or silver cyanide ; probably their composition is represented respectively by

C_7H_5CN and $C_{14}H_{10}(CN)_2$. Analogous products are formed on distilling lead acetate with lead sulphocyanate; acetonitrile, divinyl, and about 50 per cent of new cyanogen compounds are obtained. The latter decompose partially on distillation; the portion first collected, an oil insoluble in water, gave sodium acrylate and ammonia on treatment with soda-solution. The formation of acrylate was demonstrated by the preparation and analysis of the well-characterized silver salt.

It is evident from the above that this paper contains a large number of results of the highest interest, and it is to be hoped that no time will be lost in elaborating and confirming them; the descriptions in many cases are unfortunately brief. (32)

ANTHRAPURPURINE.—A NEW COLOR.

By W. H. Perkin, F.R.S.—Commercial artificial alizarine, when introduced as a dyeing agent, was generally supposed to contain purpurine, owing to the pureness of the red colors it produced with alumina mordants; but in a paper which I had the honor of reading before the Chemical Society some time since, this idea was shown to be incorrect; in the same paper, however, the existence in this product of a coloring matter differing from alizarine was pointed out.

To obtain this substance, which I propose to call *anthrapurpurine*, from commercial artificial alizarine, I have tried various methods, amongst these repeated crystallization from solvents; but this has not enabled me to separate it perfectly from the alizarine and other products with which it is associated, although its solubility differs considerably from them. I was, therefore, obliged to have recourse to chemical processes for its separation.

Instead, however, of converting the commercial alizarine into a lake as I previously did, and then treating it with an alkaline carbonate, I find it more convenient to dissolve the crude coloring matter in dilute sodium carbonate, and then well agitate the resulting solution with freshly-precipitated alumina, which combines with the alizarine, leaving the anthrapurpurine in solution. This is filtered off from the alizarine lake, heated to boiling, and acidified with hydrochloric acid. The coloring matter which is precipitated is then collected on a filter, washed, and dried. The anthrapurpurine thus obtained is very impure. These impurities can be removed to a considerable extent by repeatedly boiling the product with alcohol, anthrapurpurine being but little soluble in that menstruum. I have usually performed this operation nine or ten times; but the resi-

dual product, after crystallization from glacial acetic acid, has not given very satisfactory results, although analyzed several times. To further purify it, I have found it best to digest it with boiling alcoholic soda, and collect the difficultly soluble sodium-compound which forms on a filter and wash it several times with dilute alcoholic soda. This is then dissolved in water, boiled, and the coloring matter precipitated with barium chloride; the purple barium compound thus obtained is collected on a filter, washed a few times with hot water, and then decomposed by boiling with sodium carbonate; the resulting purple solution is filtered off; and the anthrapurpurine precipitated with hydrochloric acid. After this has been collected on a filter, it is well washed with water, dried, and finally twice crystallized from glacial acetic acid.

Anthrapurpurine, when heated, at first fuses and then evolves orange-colored vapors, which condense as yellowish-red leaves or needles, but by far the largest quantity of the substance is carbonized. It is difficultly soluble in alcohol and ether, but rather more soluble in glacial acetic acid. It is deposited from the boiling acetic solution on standing, in small fungoid-looking groups of minute orange-colored needles. These groups are generally not more than 2 or 3 mm. in diameter, and from the direction of the crystals, generally appear lighter on the under side than on the upper. They can only be seen to advantage under the microscope. As this substance dissolves but slowly in boiling glacial acetic acid, it is sometimes necessary to distill off part of the acid before the resulting solution can be made to deposit crystals.

Anthrapurpurine is very slightly soluble in water, and may be removed from its aqueous solution by means of ether. When heated with powdered zinc, it yields a hydrocarbon in small quantities, which, when purified, has the fusing-point and other properties of ordinary anthracine.

Anthrapurpurine, heated under pressure with acetic anhydride in excess to a temperature of 150°–160° for four or five hours, entirely dissolves, and the solution, on cooling, deposits a large quantity of pale yellow scales; these are easily purified by draining off the excess of acetic anhydride, and recrystallizing three or four times from glacial acetic acid. For the preparation of this compound, I find it is not necessary to use pure anthrapurpurine, the crude product before treatment with alcoholic caustic soda answering very well; but in this case the new compound should be recrystallized until the mother-liquors are of a clear pale yellow color.

This substance is a triacetylanthrapurpurine.

Triacetylanthrapurpurine melts at 220°-222°. It is not very soluble in alcohol, but is moderately so in glacial acetic acid. It crystallizes from this latter solvent in beautiful pale yellow glistening scales, as already mentioned; it decomposes when heated with alkalies.

When added gradually and in small quantities at a time to nitric acid, sp. gr. 1.5, triacetylanthrapurpurine dissolves without effervescence, forming a dark yellow solution; this on being slowly added to a large quantity of cold water, deposits a pale brown precipitate, which when collected and washed, dissolves in potash with a reddish purple color. This solution does not appear to give any bands when viewed by the spectroscope, but a considerable absorption in the orange and violet. The addition of acid causes the coloring matter to separate as an orange precipitate. This substance dyes alumina mordants of an orange color, and weak iron ones of a reddish purple.

On boiling anthrapurpurine with benzoyl chloride, hydrochloric acid is evolved, and the coloring matter quickly dissolves. The resulting product when cold becomes a viscid mass, and is purified first by repeated boilings with water, to decompose the excess of benzoyl chloride and remove a large quantity of the resulting benzoic acid, and then by crystallization from glacial acetic acid. This latter operation requires to be repeated, and, after a portion of the substance which at first separates as a yellow powder has been filtered off, the mother-liquor, on being allowed to stand, gradually yields small groups of crystals of a dark yellow or brownish color, in the form of rosettes. These, when viewed under the microscope, appear well formed and transparent.

The substance is tribenzoylanthrapurpurine.

Tribenzoylanthrapurpurine fuses at 183°–185°. It is moderately soluble in boiling glacial acetic acid. Alcoholic potash decomposes it.

Anthrapurpurine forms metallic derivatives, most of which are insoluble or nearly so in water, except those of the alkali metals.

Solutions of potassic and sodic hydrate dissolve anthrapurpurine, producing beautiful violet-colored liquids, which become blue in shade when heated. They are not so blue as those obtained with alizarine. The sodium derivative is difficultly soluble in alcohol. Anthrapurpurine also dissolves in solutions of the alkaline carbonates with a reddish purple color, from which it is precipitated by carbonic acid. A solution of sodic bicarbonate, if gently heated, dissolves anthrapurpurine more readily than alizarine.

With the chlorides of calcium, magnesium, barium, and strontium, its ammoniacal solution gives purple precipitates. Specimens of the barium precipitate have been frequently examined after drying at 170°–180°, but the results have not been satisfactory, the percentage of barium being about 2 lower than that required by the formula, $C_{28}H_{10}Ba_3O_{10}$. With alumina it forms a red lake somewhat similar to that produced with purpurine.

Cupric acetate when added to an alcoholic solution of anthrapurpurine, changes it from yellow to a beautiful purple, which can not be distinguished from that produced with alizarine under the same circumstances.

When an ammoniacal solution of anthrapurpurine is heated to 100° in a sealed tube for some hours, its purple color changes to indigo-blue. This solution, when acidified with hydrochloric acid, deposits the new product as a dark purple precipitate, which dissolves in ammonia and in sodium carbonate with a blue color, but in caustic alkalies with a red purple color. It dyes alumina mordants purple, and weak iron mordants an indigo-blue.

Anthrapurpurine has about the same affinity for mordants as alizarine. The colors it produces are also analogous to some extent, as it produces red with alumina, purple and black with iron mordants.

There is, however, a considerable difference in the shade of color produced, the reds being much purer and less blue than those of alizarine, whilst the purples are bluer and the blacks more intense. The fastness of the colors against soap and light is quite equal to those produced with alizarine.

When used to die Turkey-red, it produces very brilliant colors of a scarlet shade, which are of remarkable permanence. (32)

A NEW RED FROM ANILINE.

By F. Hamel.—If sulphur chloride be added to 20–25 grammes of aniline, with constant agitation, a red solid product is obtained almost immediately. On treatment with acetic acid and filtration, a red solution is produced, from which the coloring matter is deposited on evaporation as a black mass, soluble in acetic acid, alcohol, and ether. On addition of water to either of these solutions, a gray precipitate is thrown down.

Artificial cryolite may be made by taking crude, or better, distilled hydrofluoric acid containing 5 per cent of anhydrous acid and half saturated with pure alumina. A solution of sodium chloride is then added until the mixture contains three equivalents of soda for one of alumina. The precipitate is artificial cryolite.

AURINE.

By R. S. Dale, B.A., and C. Schorlemmer, F.R.S.—
Kolbe and Schmitt obtained in 1861 a red coloring matter by heating phenol with oxalic acid and concentrated sulphuric acid. Since that time, this color has been largely manufactured, and is found in commerce under the name of *aurine, yellow coralline,* or *rosolic acid.* The latter name, as is well known, was first given by Runge to a red body which he obtained from coal-tar, and this name was afterward employed to designate all red compounds which may be obtained from phenol by different reactions.

We refrain from giving a historical sketch of these red phenol-colors, because there can not be any doubt that, according to the mode of preparation, different compounds are formed.

The analysis of the crystallized body, which Fresenius calls *coralline,* gave numbers agreeing with the formula $C_{40}H_{28}O_{11}$. We shall have to refer to Fresenius's paper again, and will only for the present mention that his coralline is not identical with the compound which we have obtained, and for which we retain the name of *aurine.*

Commercial aurine is a brittle, resinous body, having a beetle-green lustre, and yielding a red powder.

The purification is easily effected by adding concentrated aqueous, or, better, alcoholic ammonia, to a cold, concentrated, alcoholic solution of crude aurine. A crystalline precipitate, a compound of aurine with ammonia, separates out, while the other bodies contained in the crude product remain in solution. The ammonia-compound was washed with alcohol by means of the filter-pump; after drying, it forms a dark red crystalline powder with a bluish lustre. It is a very unstable body, losing its ammonia completely when it is exposed to the air for some time.

By boiling it with dilute acetic acid or hydrochloric acid, aurine is obtained as a crystalline, brownish-red powder, having a green lustre; it must be purified by repeated crystallization from acetic acid.

By the first crystallization, it was generally obtained in small, dark red needles, with a steel-blue reflection; afterward it crystallized in larger needles or prisms, having the color of chromic acid and a brilliant diamond lustre, or of a darker shade showing a blue or greenish-blue reflection, and once we obtained it in small crystals having the beetle-green lustre of the salts of rosaniline.

The finest crystals were formed by the spontaneous

evaporation of an alcoholic solution containing acetic acid. We have analyzed these different specimens partly dried at 100° and partly at a higher temperature, and although samples of the same preparation gave very concordant results, those of different preparations varied very much in their composition. We found that the reason for this was that aurine most obstinately retains water and acetic acid, which, however, as we believe, are not chemically combined with it.

From hot concentrated hydrochloric acid, aurine crystallizes in slender red needles, which, when dried at 110°, still retain a large quantity of hydrochloric acid. We tried to obtain the pure compound by precipitating a dilute alkaline solution of aurine with weak hydrochloric acid and washing the precipitate with the filter-pump, but the product thus obtained also contained hydrochloric acid when dried at 110°.

By the spontaneous evaporation of an alcoholic solution, aurine is obtained in dull red crystals with a green lustre, which when dried at 110° do not contain any alcohol, but several per cent of water, which is given off only at a temperature above 140°.

Aurine, which has been repeatedly crystallized from acetic acid or alcohol, does not melt at 220°; at this temperature the crystals assume a darker shade, which disappears again on cooling, without any appearance of alteration in the substance. When more strongly heated, it melts, emitting at the same time the odor of phenol, and solidifies again, on cooling, to an amorphous, beetle-green mass. Aurine dissolves readily in alkalies with a magenta-red color, and is precipitated from this solution by acids as a crystalline powder.

Aurine, crystallized from a mixture of alcohol and acetic acid, forms dark red crystals, moderately thick in comparison to length.

A variety of substances derived from aurine when treated with other bodies are given fully described by the authors.

When aurine is heated carefully in a combustion-tube, a reddish-colored oily liquid distils, and a large quantity of porous carbon is formed. The distillate is almost completely soluble in caustic potash, only a trace of a solid having the odor of diphenyl being left behind. The alkaline solution was decomposed with hydrochloric acid, and the oil dried over calcium chloride. On distilling it, a small quantity of water first passed over, and the boiling-point then rose rapidly to 184°, remaining constant until the last drop had distilled over; the distillate solidified to

a mass of needle-shaped crystals, and consisted of pure phenol, no cresol being present, the formation of which might have been expected if this compound took part in the production of the color.

We may, therefore, for the present assume that the aurine contained in the commercial product is identical with that obtained from pure phenol. It is known how easily one may be deceived by the apparent purity of crystallized coloring matters; only a short time ago, Wichelhaus has again called attention to this point in his beautiful researches on the oxidation of phenol.

When aurine is heated with aqueous ammonia to 140°–150°, a new coloring is formed, dyeing on wool and silk a redder shade than aurine, and occurring in commerce under the name of "red coralline," or "pæonine."

Another derivative of aurine, called "azurine" or "azuline," is produced by treating it with aniline. An examination of this blue compound has so far yielded the following results.

When aurine is gently boiled with aniline and a little acetic acid, the solution soon assumes a pure blue color. On boiling the product with dilute hydrochloric acid, in order to remove an excess of aniline, a blue resinous substance is obtained, consisting of a mixture of different bodies, which are partly soluble in alcohol and acetic acid, and partly insoluble in them.

By heating the above mixture on a water-bath, a blue solution is formed in 16–20 hours, which, however, also contains several bodies. A portion of the product is readily soluble in caustic soda with a purple color, and precipitated by acid from this solution in blue flakes, which dissolve in alcohol and acetic acid. The portion which is insoluble in alkalies dissolves completely in acetic acid and alcohol, with a fine blue color, but ether takes up only a part of it, forming a dark red solution, which on evaporation leaves a blue resinous body behind. The portion not dissolving in ether forms a dark blue powder with a golden reflection. (32)

TESTING GLASS FOR THE PHOTO-DARK-ROOM.

By Le Neve Foster.—A small strip of white paper, or of silver wire, placed on a black ground, is viewed through a prism, the glass under investigation being interposed between the paper and the prism. When yellow glass is employed, all blue lines do not disappear; ruby-red glass, however, absorbs all the blue and green of the spectrum, showing that it is best fitted for the purpose of absorbing the actinic rays, and thereby preventing chemical action. (36)

NEW ANILINE VIOLET.

By A. W. Hofmann.—Hobrecker prepares a new aniline violet by acting with benzyl chloride and methyl iodide on a solution of rosaniline in methyl alcohol. The compound thus obtained has the composition $C_{20}H_{16}(C_7H_7)_3N_3.CH_3I$, and forms beetle green needles, which are almost insoluble in water, and dissolve sparingly in cold, more freely in boiling alcohol. (32)

FREEZING-POINTS OF ACETIC ACID AND WATER.

By E. Grimaux.—The addition of water to glacial acetic acid lowers the freezing-point down to a certain limit, beyond which the further addition of water raises it. The author has endeavored to ascertain this limit by experiment. He introduced mixtures of acetic acid and water (in proportions determined by weighing) into a small test-tube furnished with an alcohol thermometer, the zero-point of which was verified every day, and placed the arrangement in a freezing mixture. When the thermometer had sunk some degrees below the expected freezing-point of the mixture, the test-tube was shaken to cause solidification of its contents, and the highest point to which the thermometer rose at the moment of crystallization was read off. The standard acetic acid employed solidified at 14.4°, and hence, according to Rüdorff's tables, contained 1.25 p. c. of water.

The lowest freezing-point of the solution obtained was 24.1° which corresponds to a mixture containing 37 or 38 p. c. of water, that is, to an acid represented by the formula $C_2H_4O_2 + 2H_2O$. (4, 32)

THE BITTER APPLE AS AN ARTICLE OF FOOD.

By F. A. Flueckiger.—The bitter apple, bitter cucumber, bitter gourd, or colocynth (*Citrullus Colocynthis* Schrader) is a creeping cucurbitaceous plant which grows abundantly in the Sahara in Arabia, and on the Coromandel Coast, and is found in some of the islands of the Ægean Sea. The fruit, which is about as large as an orange, contains an extremely bitter and drastic pulp, from which colocynth is obtained. This pulp is said to be eaten by buffaloes and ostriches, but is quite unfit for human food. The seed-kernels, however, which contain but a very small quantity of bitter principle, are used as food by some of the natives of the African desert. For this purpose, the seeds are first freed from pulp by roasting and boiling, and subsequent treading in sacks, and then deprived of their coatings—which are also decidedly bitter—by grinding and winnowing. (32)

ACIDS IN WINE.

BY GRAEGER.—Old wines have an acid reaction, in consequence of the presence of a certain amount of free acid and potassium bitartrate. A wine not exhibiting this acid reaction tastes flat; the acidity is its most important flavor. For a long time it has been believed that the free acid of wine is tartaric acid alone. Nessler's researches have, however, shown that this is seldom the case, frequently tartaric and malic acids existing together, and more frequently the free acid consisting of malic acid entirely. Wines containing tartaric acid alone taste more tart than those with only malic acid, or a mixture of malic and tartaric acids. Nessler shows that only in rare cases does the free acid in grapes consist solely of tartaric acid; in most cases a mixture of malic and tartaric acids is present in variable proportions. (32)

TESTING ALCOHOL.

IT is customary to obtain the percentage of absolute alcohol and water in mixtures of alcohol by taking the specific gravity with a hydrometer especially adapted to the purpose and called an alcoholometer. When a liquor contains syrups and extractive matters, the specific gravity fails to indicate the amount of alcohol present. In such cases, it has been necessary to distill off the alcohol and then measure it.

In these cases, and also where no alcoholometer is at hand, or the quantity of the liquid is too small to float one, Vogel's method may be employed. He found that, when dry starch-paper was dipped into a solution of iodine in alcohol of 66.8 per cent or over, the starch was not turned blue. If the spirits contained less than 66.8 per cent absolute alcohol, the paper is immediately blued. To apply the test to weaker alcohols, it is only necessary to add absolute alcohol until the reaction no longer takes place. From the quantity added it is easy to calculate the percentage. If the spirit tested is above 66.8, water is added from a graduated measure until the starch-paper turns blue, and the percentage calculated from the quantity of water added. If potassium be thrown upon alcohol of specific gravity 0.830, it takes fire; but with spirits of specific gravity 0.823 and under, it will not take fire.

SILVERING OF GLASS.

BY R. SIEMENS.—As a reducing agent, acetic aldehyde is used in the form of aldehyde-ammonia, prepared by passing dry ammoniacal gas into aldehyde. Four grammes of silver nitrate and $2\frac{1}{2}$ grammes of aldehyde-ammonia are separately dissolved in a litre of distilled water and the

solutions mixed and filtered. The article to be silvered, after washing out with solution of potassium carbonate and then with spirits of wine and distilled water, to remove every trace of grease, is filled with this solution (as far as it is desired to silver) and then hung up in the water-bath. It is now gradually heated, and as soon as the temperature reaches 50°, the separation of the silver mirror begins, and soon spreads over the whole inner glass surface. Its formation is soon finished, usually between 55° and 60°. When the beauty of the silvered surface reaches a maximum, it is time to withdraw the article from the water-bath and pour off the contents, or the brilliancy of the mirror will be impaired. The article is finally rinsed in distilled water. (36)

ACTION OF PLATINUM AND PALLADIUM ON THE HYDROCARBONS.

THE recent experiments of M. Coquillon on the above subject take as a point of departure the fact that a platinum wire, rolled in spiral form and heated to redness, remains incandescent in presence of vapors of alcohol or ether, and forms different products, of which the principal are aldehyde and acetic acid. All mono-atomic alcohols, as well as their ethers, act in analogous manner, and produce, in this incomplete combustion, aldehyde and the acid corresponding to the alcohol; while all the hydrocarbons, volatile oils, aniline, etc., participate in this property and maintain the incandescence of the platinum spiral. The fixed oils and sulphureted essences, such as the essence of garlic or mustard, are without this effect.

Palladium has this property of remaining incandescent in hydrocarbureted vapors in even a greater degree than platinum; and with toluol, it similarly produces hydride of benzoyl. When it is plunged in an incandescent state into proto-carbureted hydrogen, it continues in the same condition without requiring to be brought to redness by the battery. With bicarbureted hydrogen, while the platinum wire gives frequent explosions, palladium causes none. It extinguishes itself when the gaseous mixture is no longer suitable. Another curious peculiarity is that its surface becomes rough and wrinkled, and the spirals break, after a few days' experimenting. The weight is also sensibly diminished.

MERCURY melts at 39° F. below zero. Brass melts at 1900° F. Ice melts at 32°. India-rubber vulcanizes at 293°. Steel takes on the blue color at 580°, and the straw color at 460°. The alloy 1 part lead, 1 bismuth, 1 tin, 4 of cadmium, melts at 155°F.

SIEMENS'S IMPROVEMENTS IN THE MANUFACTURE OF STEEL AND IRON DIRECT FROM THE ORE.

IN the working of the improvements shortly to be described, Dr. C. W. Siemens makes use of the celebrated fuel-saving apparatus invented by himself and F. Siemens, known as the Regenerative Gas-furnace. A concise and interesting account of this remarkable invention was lately given by the Doctor himself, before the British Association, which is as follows:

THE SIEMENS REGENERATIVE GAS-FURNACE.

Taking the specific heat of iron at .114, and the welding-heat at 2700° Fahr., it would require .114 × 2700 = 307 heat units to heat 1 lb. of iron. A pound of pure carbon develops 14,500 heat units, a pound of common coal 12,000, and therefore 1 ton of coal should bring 39 tons of iron up to the welding-point. In an ordinary reheating furnace, a ton of coal heats only 1¾ tons of iron, and therefore produces only one twenty-third part of the maximum theoretical effect. In melting 1 ton of steel in pots, 2½ tons of coke are consumed, and taking the melting-point of steel at 3600° Fahr., the specific heat at .119, it takes .119 by 3600 =428 heat units to melt a pound of steel; and taking the heat-producing power of common coke also at 12,000 units, 1 ton of coke ought to be able to melt 28 tons of steel. The Sheffield pot-steel melting furnace therefore only utilizes one seventieth part of the theoretical heat developed in the combustion. Here, therefore, is a very wide margin for improvement, to which I have specially devoted my attention for many years, and not without the attainment of useful results.

Without troubling you with an account of the gradual improvements, I will describe to you shortly the furnace which I now employ for melting steel. This consists of a furnace bed made of very refractory material, such as pure silica sand and silica or Dinas brick, under which four regenerators or chambers filled with checkerwork of brick are arranged in such a manner that a current of combustible gas passes upward through one of these regenerators, while a current of air passes upward through the adjoining regenerator, in order to meet in combustion at the entrance into the furnace chamber. In Fig. 2 a portion of the checkerwork of one of the regenerating chambers is seen. The products of combustion, instead of passing directly to the chimney as in an ordinary furnace, are directed downward through the two other regenerators on their way toward the chimney, where they part

with their heat to the checkerwork in such a manner that the highest degree of heat is imparted to the upper layers and that the gaseous products reach the chimney comparatively cool, (about 300° Fahr.) After going on in this way for half an hour, the currents are reversed by means of suitable reversing valves, and the cold air and combustible gas now enter the furnace chamber, after having taken up heat from the regenerator in the reverse order in which it was deposited, reaching the furnace therefore nearly at the temperature at which the gases of combustion left the same. A great reversion of temperature within the regenerative chambers is the result, and the two first mentioned regenerators are heated to a higher degree than the latter. It is easy to conceive that in this way heat may be accumulated within the chamber to an apparently unlimited extent, and with a minimum of chimney draught. Practically the limit is reached at the point where the materials composing the chamber begin to melt, whereas a theoretical limit also exists in the fact that combustion ceases at a point which has been laid down by St. Clair Deville at 4500° Fahr., and which has been called by him the point of dissociation. At this point, hydrogen might be mixed with oxygen, and yet the two would not combine, showing that combustion really only takes place between the limits of temperature of about 600° and 4500 Fahr. To return to our regenerative gas furnace. It is evident that there must be economy where, within ordinary limits, any degree of heat can be obtained, while the products of combustion pass in the chimney only 300° hot. Practically a ton of steel is melted in this furnace with 12 cwt. of small coal consumed in the gas-producer, which latter may be placed at any reasonable distance from the furnace, and consists of a brick chamber containing several tons of fuel in a state of slow disintegration. In large works, a considerable number of these gas-producers are connected by tubes or flues with a number of furnaces.

MANUFACTURE OF STEEL.

In a recent lecture before the Chemical Society, Dr. Siemens gives the following information concerning the practical working of his other processes :

These processes have now received very considerable practical development at the works of the Landore-Siemens Steel Company, of Messrs. Vickers & Company of Sheffield, and at several other works. Two processes are employed at these works, the Siemens-Martin process, which consists in dissolving scrap metal or steel in a bath of pig-metal to which spiegeleisen is finally add-

ed, and the ore-reducing process in which pig-metal and ore in a more or less reduced condition is employed.

The process chiefly employed at the Landore Works consists of introducing on the bed of an intensely heated regenerative gas furnace about 6 tons of pig-metal, which may be No. 3 or 4 hæmatite pig. When a fluid bath has been formed, oxide of iron (which should by preference have been melted beforehand with such proportions of lime or other fluxing materials as to form with the silica in the ore and in the pig-metal a convenient slag) is added, or natural ores may be used in their raw condition if they contain lime and manganese, as, for example, the African Mokta ore. When about 30 cwt. of this ore have been dissolved (with ebullition) in the metallic bath, it is found that a sample taken from it contains only about .1 per cent of carbon; a point which can easily be detected by the eye of the workmen by a peculiar bright appearance of the sample when chilled in water and broken by the hammer.

When the requisite point of decarburization has been reached, the supply of ore must be stopped, and from 8 to 10 per cent of ferro-manganese or spiegeleisen added to the bath. When this has been well incorporated by stirring, the metal is ready to be tapped into a ladle mounted upon wheels, which is afterward propelled into the foundry, and discharged either into ingot moulds, to be hammered and rolled, or into dry clay moulds for the production of steel castings.

Considerable difficulty was experienced to find a material to resist the excessive heats necessary for carrying out this process; ordinary Dinas bricks, which are considered the most refractory material in general use, would be rapidly melted, but a brick specially prepared by crushing pure quartz rock, and mixing it with no more than 2 per cent of quicklime to give cohesion, answers well. The hearth of the furnace is made of white sand with a small admixture of more fusible fine sand, which mixture sets exceedingly hard at a steel-melting heat, and possesses the advantage of combining into a solid mass with fresh materials introduced between the charges to make up for wear and tear.

If good pig-metal, such as is used in the Bessemer process, is employed, a metal of high quality is the result, equaling, in most respects, the steel produced by melting Swedish bars in pots by the old Sheffield process.

At the Landore Works, upward of 1000 tons of cast-steel are produced weekly by these processes, and other works, such as Vickers & Company, Krupp, of Essen, etc., are using the same for the production of steel of high quality.

Both in the ore-reducing and in the Siemens-Martin or scrap process, pig-metal forms the principal basis, being used either as such, or as puddled iron or Bessemer scrap-metal, resulting from the conversion of pig-metal by a previous process.

THE SIEMENS PROCESS FOR MAKING IRON AND STEEL DIRECT FROM THE ORE.

I have heretofore expressed my belief that the direct conversion of ores into iron or steel would ultimately be accomplished, and I have since been actively engaged on the problem.

I am aware that, on the one hand, the direct conversion of iron ores into wrought-iron or steel is no novelty, inasmuch as the ancient Indians and Romans produced their iron by a direct process from the ore; and that, on the other hand, the blast-furnace offers immense facilities for the wholesale extraction of metal from the ore, by the side of which the puny efforts of the ancients producing half a cwt. of metal intermixed with half-fused cinder by a day's toil, and with the expenditure of large quantities of rich ore and charcoal, sink into utter insignificance.

Fig. 1 shows the distribution of temperature in the blast-furnace, as given by Mr. Lowthian Bell. It shows that the reduction of the metallic oxides to spongy iron is accomplished within the first 20 feet of their descent in the furnace, and at a comparatively low temperature. This upper zone is followed by one where the limestone is decomposed and the carburization of the spongy metal is commenced. Between this second zone and the zone of fusion in the boshes of the furnace a zone of great magnitude intervenes, where apparently no other change is effected than an increase of temperature of the spongy metal, but where in reality a very powerful reducing action is accomplished of substances which had much better not be joined to the iron. It is well known that almost all the phosphorus contained in the iron-stone, the lime-stone, and the coke is here incorporated with the spongy iron. The silica is reduced to its metallic condition, and, together with sulphur, arsenic, and other bases which may be present, combines with the iron. The final action in the blast-furnace consists only in fusing those reduced substances and forming the slags which envelop and protect the fused metal.

As regards the fuel question, it will be observed that the result of the combustion in the blast-furnace is for the most part carbonic oxide, and that the heat developed in

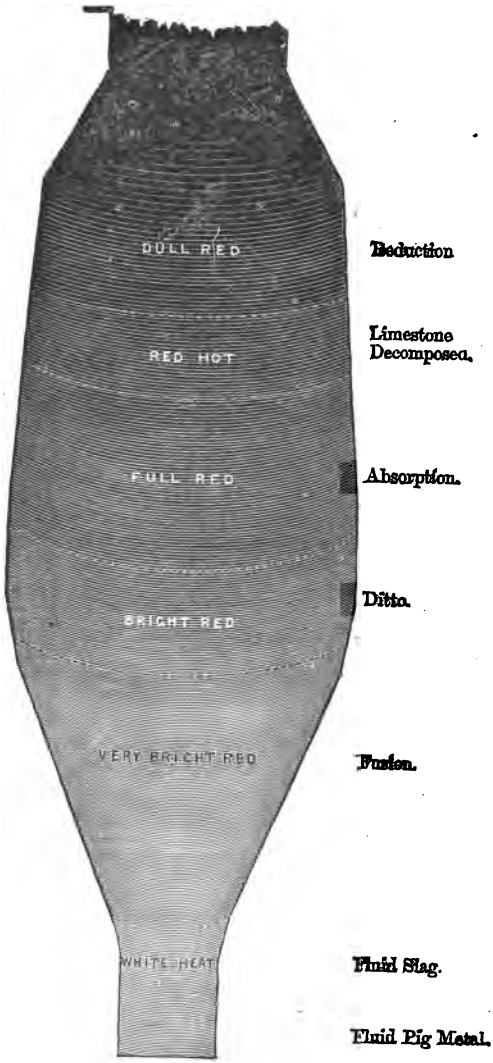


FIG. 1.—DISTRIBUTION OF TEMPERATURE IN THE ORDINARY BLAST-FURNACE.

this combustion amounts to only 2400 heat units per pound of pure coke consumed, whereas a perfect combustion (to carbonic acid) of the same coke would be attended by the development of 8000 heat units. It is practically impossible to obtain more than one fifth of carbonic acid to the carbonic oxide issuing from the top of the blast-furnace, and it may, therefore, fairly be asserted that only one third of the heat-producing power residing in the coke is utilized in this furnace. A portion of the heat thus left undeveloped may be used, it is true, in burning the gases for the generation of steam or for heating the air blown into the blast-furnaces; but this utilization represents only a small proportion of the value of the coke or charcoal charged with the ore into the furnace; whereas a much cheaper material might be employed for the purposes just named. The introduction of hot blast was unquestionably a very great improvement in blast-furnace economy, because the heat thus introduced is obtained by means of the perfect combustion of fuel, and, in reducing the combustion necessary within the furnace, the quantity of products of combustion as compared to a unit quantity of ore is greatly reduced, the effect being that the incoming ores have a relatively greater capacity for absorbing the sensible heat from the products of combustion, which latter must therefore issue from the top of the furnace at a lower temperature.

Relying upon this argument, I am inclined to believe that the consumption of coke in a blast-furnace must materially diminish with increased temperature of blast without limitation of degree, and in this respect I venture to differ from my friend Mr. Lowthian Bell, who maintains that mere increase of capacity of furnace up to a certain limit produces the same effect as increase of temperature of blast, and that no beneficial effect can be obtained by increasing the temperature of blast beyond 515° C. In taking, however, the best examples of blast-furnaces, the products of combustion escaping from the top, four parts out of five, as CO without counting the N and at not less than 350° C. of sensible heat, carry with them fully two thirds of the heat they would be capable of producing if they were burnt to carbonic acid.

It occurred to me that by melting ores mixed with fluxing materials in a furnace so arranged as to accomplish its fusion in a continuous manner, and on a large scale, the fused ore might be acted upon by solid carbonaceous matter, so as to separate the metallic iron in a more compact form, while the earthy constituents of the ore would form a fusible slag with the fluxing material. Experimentsproved

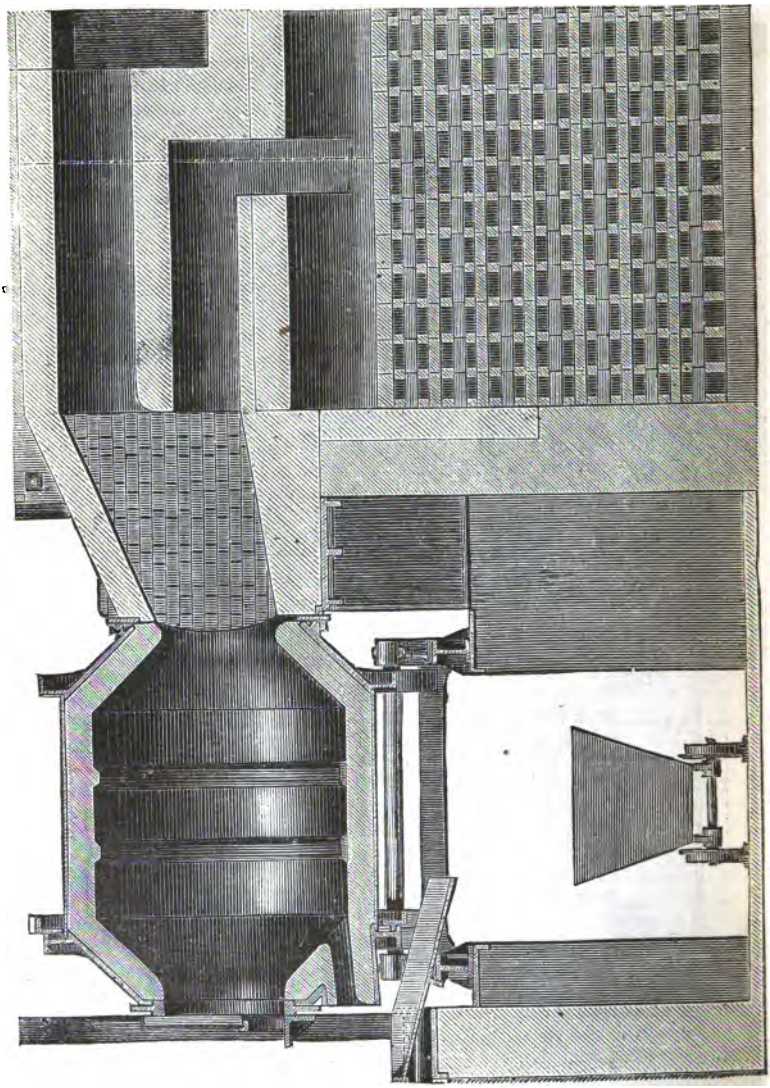


FIG. 2.—LONGITUDINAL SECTION OF SIEMENS'S ROTARY FURNACE.

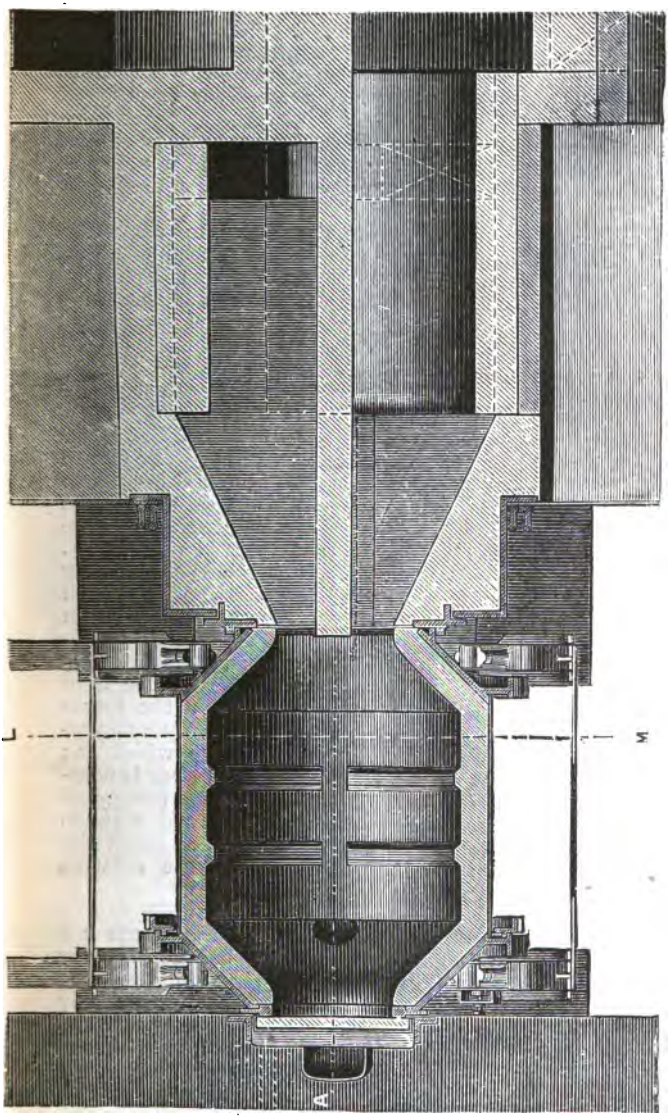


FIG. 3.—SECTIONAL PLAN OF SIEMENS'S ROTARY FURNACE.

that this reduction by precipitation of the iron could be accomplished only at an intense heat, exceeding the welding heat of iron, but that the iron so produced was almost chemically pure, although the ores and the fuel used might contain a very considerable percentage of sulphur and phosphorus.

It was evident that if iron and steel were to be produced largely by direct process, that process must be a self-acting or mechanical one, and here my attention reverted to the rotating furnace.

Figures 2, 3, 4, and 5 represent the complete rotary furnace, such as is now in use at Messrs. Vickers & Co.'s, at Sheffield, and at my Sample Steel Works at Birmingham. It consists of a set of four regenerators of the usual construction, with reversing valves and gas-producers, which latter are not shown. The rotative chamber is constructed of iron, and rests upon four anti-friction rollers. Wheel-gearing is applied, by which either a very slow rotative velocity of from four to five revolutions per hour can be imparted to the chamber, or a more rapid velocity of about sixty to eighty revolutions per hour. The chamber is about 7′ 6″ in diameter and 9′ 0″ long, and is provided with a Bauxite lining about 7″ thick. A tap-hole is on the working side for discharging the slag into the cave below, where it is received in vessels mounted on wheels. At the two extremities of the cylindrical rotative chamber with its truncated ends, are large orifices, one of which, on the side of the regenerators, serves for the introduction of the heated gas and air as well as for the exit of the products of combustion, and the other facing the working platform is closed by a stationary door hung before it in the usual manner. Although the passage for the introduction of gases in combustion is separated only by a vertical partition wall from the passage through which the products of combustion are led away, the chamber is heated very perfectly, care only being taken that the gases enter the chamber with a certain velocity, which sends them forward toward the door and makes them reach the exit passage only after having traversed the rotative chamber to and fro.

This rotative furnace is worked as follows:

The ore to be smelted is broken up into fragments not exceeding the size of peas or beans; to it is added lime or other fluxing material in such a proportion that the gangue contained in the ore and flux combines with only a little protoxide of iron into basic and fluid slag. If the ore is hæmatite, or contains silica, I prefer to add alumina in the shape of aluminous iron ore; manganiferous iron

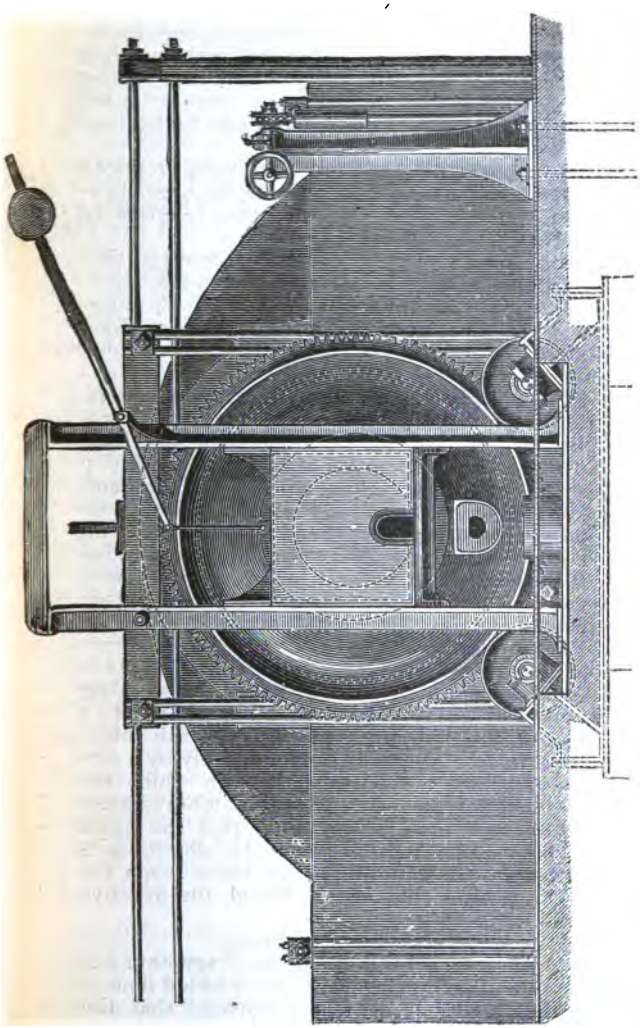


FIG. 4.—FRONT ELEVATION OF SIEMENS'S ROTARY FURNACE.

ore may also be added with advantage. A charge of say 20 cwt. of ore is put into the furnace when fully heated, while it is slowly revolving. In about forty minutes, this charge of ore and fluxing material will have been heated to bright redness, and at this time from 5 cwt. to 6 cwt. of small coal of uniform size (not larger than nuts) are added to the charge, whilst the rotative velocity is increased in order to accelerate the mixture of coal and ore. A rapid reaction is the result: the peroxide of iron being reduced to magnetic oxide begins to fuse, and at the same time metallic iron is precipitated by each piece of carbon, while the fluxing materials form a fluid slag with the siliceous gangue of the ore. The slow rotative action is again resorted to, whereby the mass is turned over and over, presenting continually new surfaces to the heated lining and to the flame within the rotator.

During the time of this reaction, carbonic oxide gas is evolved from the mixture of ore and carbon, and heated air only is introduced from the regenerator, to effect its combustion within the rotating chamber. The gas from the gas-producers is entirely, or almost entirely, shut off during this portion of the process. When the reduction of the iron ore is thus nearly completed, the rotator is stopped in the proper position for tapping off the fluid cinder; after this the quick speed is imparted to the rotator, whereby the loose masses of iron contained in it are rapidly collected into two or three metallic balls. These are taken out and shingled in the usual way of consolidating puddled balls; the furnace is tapped again and is ready to receive another charge of ore. The time occupied in working one charge rarely exceeds two hours; and supposing that 10 cwt. of metallic iron is got out per charge, the apparatus is capable of turning out at least 5 tons of puddled bar per diem. If anthracite or hard coke is available for effecting the reduction of the ore, it should be crushed much finer than when coal or brown coal is used, the idea being that each particle of the reducing agent should be fully consumed during the period of chemical reaction. If wood is used, it has to be charged for the same reason in still larger pieces.

If it is not intended to make iron, but cast-steel, the balls may be transferred from the rotator to the bath of a steel-melting furnace in their heated condition, and without subjecting them to previous consolidation under a hammer or shingling machine.

It is feasible, however, to push the operation within the rotator to the point of obtaining cast-steel. If this is intended, the relative amount of carbonaceous matter is

somewhat increased in the first instance, so that the ball, if shingled, would be of the nature of puddled steel, or contain even some carbon mechanically inclosed.

If now, after removing the cinder by tapping, from 10 to 15 per cent of ferro-manganese or spiegeleisen is thrown in, and the heat within the rotator is rapidly raised by urging the influx of heated gas and air from the regenerator, the metallic balls will soon be seen to diminish, and presently a metallic bath only will be found in the furnace, which may be tapped into moulds and hammered and rolled into steel blooms or bars in the usual manner. Experience alone can determine which mode of working will ultimately prove the best: but it is probable that for

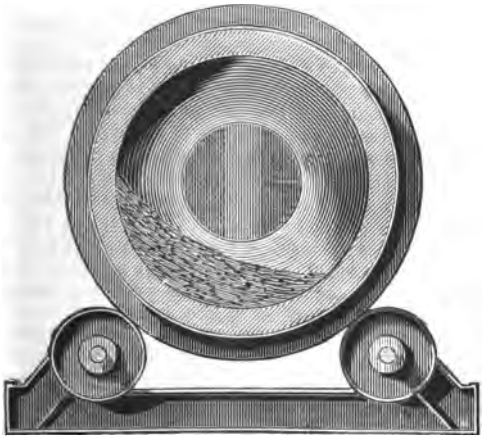


FIG. 5.—ROTARY FURNACE. SECTIONAL FRONT ELEVATION.

the production of cast-steel on a large scale it will always be more profitable to transfer the metallic balls to a separate melting-furnace, a series of rotating furnaces working in concert with a series of steel-melting furnaces, to produce charges of 5 to 6 tons of fluid steel.

In comparing upon theoretical grounds this method of producing metallic iron with the operation of the blast-furnace, it will be at one perceived that, whereas in the blast-furnace the products of combustion consist chiefly of carbonic oxide, and issue from the top of the furnace at a temperature exceeding 350° C., the result of combustion in the rotative furnace is carbonic acid, which issues from the regenerative furnace into the chimney at a temperature rarely exceeding 175° C. This proves at once a great possible saving of fuel in favor of the proposed

method, and to this saving has to be added the fuel required in converting pig-metal into wrought-iron by the puddling process.

It may, however, be asked, why the rotating furnace should admit of the complete combustion of carbon, whereas, in the blast furnace, such complete combustion is, as is well known, not possible, because each atom of carbonic acid formed would immediately split up into two atoms of carbonic oxide, by taking up another equivalent of carbon from the coke present. The following explanation will serve to elucidate this point:

In the rotative furnace, streams of carbonic oxide are set up within the mass under reaction; and this carbonic oxide on reaching the surface meets the current of intensely heated air proceeding from the regenerators, and completes with it perfect combustion within the free space of the chamber. The carbonic acid thus generated comes in no further contact with carbon, consequently it can not split up, but is drawn away unchanged into the chimney, while the evolved heat is taken up by the sides of the chamber and transmitted by reverberation and conduction to the mixture of ore, fluxes, and coal.

In this process we have, therefore, to accomplish two things, namely, the deoxidation of the ore, and the fusion of the earthy matter mixed with it. If we take (say) hæmatite ore, consisting of peroxide of iron with 10 per cent of silica, we shall determine the quantity of carbon necessary for its reduction from the formula

$$Fe_2O_3 + 3C,$$

which gives $2Fe + 3CO$;

and according to which the consumption of carbon (taking its atomic weight at 12 and that of iron at 56) amounts to

$$\frac{3 \times 12}{2 \times 56} = .32 \text{ lbs. per lb. of iron reduced.}$$

The heat absorbed in this reaction amounts, according to Dr. Debus, to 892 units per lb. of iron produced; but, on the other hand, the further combustion of .32 lb. of carbon from the condition of carbonic oxide to carbonic acid, or from CO to CO_2, by means of the free oxygen introduced into the rotative chamber from the regenerator, yields

$$.32 \times 5600 = 1792 \text{ units of heat}$$

leaving

$$1792 - 892 = 900 \text{ units}$$

available for heating the materials and for melting the slag.

The quantity of materials to be heated per lb. of iron produced would amount to

Ore	1.59
Lime or other fluxing materials	.16
Total	1.75

and taking the specific heat of Fe_2O_3 at .154, as determined by Herman Kopp, and the temperature to which the materials have to be raised at 1500° C., the heat required for this purpose would not exceed

$$1.75 \times .154 \times 1500 = 403.5 \text{ units.}$$

To this consumption would have to be added the latent heat absorbed in liquefying the slag. This would amount to .32 pound per lb. of iron produced, and although we have no precise data from which we could ascertain the latent heat absorbed in liquefaction, we can hardly estimate it at more than 400 units per lb. or at $.32 \times 150 = 88$ units, which, with the above 403.5, makes 451.5 units, or 448.5 units under the 900 heat-units which are available, proving that .32 lb. of pure carbon would, theoretically speaking, amply suffice to produce 1 lb. of puddled bar from ordinary hæmatite ore, without counting, however, losses of heat by radiation and from other causes.

In the production of cast-steel, three operations are essentially involved, namely, the deoxidation of the iron, the fusion of the slags, and the fusion of the metal itself with such proportion of carbon and manganese as is necessary to constitute steel of the temper required.

The theoretical quantity of fuel required to accomplish these operations would exceed that of making wrought-iron by the fusion of heated metal, which may be estimated at say 1000 units, or at $\frac{1000}{8000} = .125$ lb. of carbon per lb. of steel produced, which have to be added to the .32 lb. used in reduction.

In fine, a ton of iron ought to be producible from hæmatite ore with 6.4 cwt. of carbonaceous matter, or say 8 cwt. of common coal, and a ton of cast-steel with 8.91 cwt. of carbon, or say 11 cwt. of coal. In giving these figures, I do not wish to imply that they will ever be completely realized, but I maintain that, in all our operations, we should fix our eyes upon the ultimate result which theory indicates, which, owing to the imperfect means at our command, we shall never completely realize, but which we should constantly endeavor to approach.

In taking incidental losses by radiation through imperfect combustion and through imperfect absorption of heat into account, we find that the actual consumption exceeds

the theoretical limits about three times, or that a ton of iron can practically be produced with a consumption of 14 cwt. of coal, and a ton of cast-steel with 12 cwt. of coal, which consumption represents a great reduction as compared with other methods of production.

FLUORENE.

BY BARBIER.—Berthelot discovered in the portion of coal-tar distilling at 300°–340°, a very fluorescent substance, to which he gave the name of *fluorene*, without attributing any definite formula to it. It is best obtained by modifying his method so far as to make the first crystallization of the portion distilling at 300°–305° from a mixture of alcohol and benzine. By this operation, a small quantity of acenaphthene is separated, and the melting-point is raised to 112°, that is to say, 7° higher than when the substance is crystallized from alcohol only. After another crystallization from pure alcohol, the hydrocarbon melts at 113°. The composition of fluorene is represented by the formula $C_{13}H_{10}$. (32)

NEW EXPERIMENTS ON RESPIRATORY COMBUSTION.

BY A. ESTOR AND C. ST. PIERRE.—By injecting a solution of glucose into the femoral vein of a dog, and immediately examining blood from the femoral artery on the other side, the authors find that the glucose is rapidly destroyed, and that during its presence the oxygen disappears. As the result of their experiments, they consider that respiratory combustion occurs in the arteries. (4)

CHLORIDE OF IRON OBTAINED BY DIALYSIS.

IT is now many years since the late Professor Graham discovered that when a solution contained both crystallizable and uncrystallizable, or colloid, substances, the former would pass much more rapidly through an animal membrane than the latter. For performing this experiment, a hoop of hard rubber has a piece of parchment paper stretched over it, and the apparatus, which resembles a sieve, is allowed to float upon the surface of the water. The mixed solution is poured into the apparatus, and in a few days the greater part of the crystallizable body will be found in the water, while the uncrystallizable one will remain on the membrane. Professor Graham gave to this process of separation the name of "dialysis," and to the apparatus that of "dialyzer," which names have been generally adopted in all languages.

Since the discovery of dialysis, it has found many uses. It has been used with great advantage in analytical che-

mistry, for separating crystalloid and colloid bodies, especially organic ones. Its greatest value has been in analyzing the contents of the stomach, when it is desired to show that poison has been taken. The presence of a poison in the slimy contents of the stomach would otherwise be difficult to prove. Recently it has also been employed in the arts, and Dr. Reimann describes in his *Farberzeitung* its use in the dye-house for preparing iron salts: From mixed solutions of salts and gum, the salts can be separated while the gum remains behind. But not only so; when a salt alone is placed in the dialyzer, the crystallizable portion of the salt, which is usually the acid, passes through the membrane first, the base remaining on the dialyzer. Now, there are a series of salts which require a proportionately large quantity of acid to keep them in solution. Notable among these are the sesquioxides, especially that of iron. The very acid salt of iron is extensively employed in dyeing silk as an iron mordant for heavy black. An iron mordant which is very acid and which generally contains an excess of nitric acid, as well as some nitrous acid, acts destructively upon the fibre, so that very heavily weighted black silk loses a greater part of its strength, and sometimes can be pulled apart. To avoid this disadvantage, the iron may be used in the form of dialyzed oxide of iron.

In preparing such a solution, oxide of iron dissolved in muriatic acid (perchloride of iron) is placed in a dyalizer. After some time, it will be found that the acid is mostly gone off, while a solution of the oxide of iron remains in the dialyzer. Such a solution gives up its oxide of iron very readily to the immersed fibre, which is thoroughly mordanted, while it can not be attacked, since there is no acid, at least no excess of it, present. Such a solution is far more active than the ordinary iron mordant, because the iron in it has a great tendency to deposit itself upon the fibre, while that in the acid mordant, being held by the acid, shows less of this tendency. It seems, too, from what has been learned, that the mordanting of fibres in a solution of salt is really a phenomenon of dialysis. The fibres may be regarded as a conglomerate of membranes, and hence it is natural that the silk, for instance, should take out the iron from a solution of its salt, and allow the acid to disseminate itself through the bath. This tendency of the fibre to take up the iron is assisted by previous dialysis of the solution.

For technical purposes, especially for weighting silk, it is necessary to take away all the acid from the oxide solution. Here it is sufficient to obtain a solution containing but little acid and an excess of oxide of iron.

Fr. Oltmanns, an apothecary in Hanover, has for years prepared dialyzed oxide of iron for medical purposes, and recently has also made it for use in dyeing. The dialyzed oxide of iron made by him contains 6 to 7 per cent of pure sesquioxide of iron in solution; a quantity which, because of the ease with which it acts on the fibre, is more than sufficient for most purposes. For weighting silk, and for many similar purposes in the dye-house, especially for all cases where it is desirable to load the fibre heavily with the oxide of iron in mordanting, without attacking it, dialyzed iron is invaluable.

FORMATION AND PROPERTIES OF OZONE.

By R. Lamont.—When phosphorus is allowed to oxidize in air or oxygen gas, phosphorous pentoxide and ozone result. An atom of oxygen can not exist in the free state, but a molecule can, which in this case consists of two atoms, (O-O.) Phosphorous pentoxide consists of a molecule of phosphorus combined with two molecules + an atom of oxygen. When phosphorus is left to oxidize in oxygen, the molecule of phosphorus combines with two molecules of oxygen, but this not being sufficient to form the pentoxide, it must have another atom of oxygen, which it can only get by splitting up a molecule of oxygen—one of the resulting atoms combining with the phosphorus, the other atom going to a molecule of oxygen to form ozone, (O-O-O.) If the ozone which has been formed is allowed to remain in contact with the phosphorus, it is decomposed thus:

$$P_2+(O\text{-}O\text{-}O)+(O\text{-}O\text{-}O)+(O\text{-}O\text{-}O)=P_2O_6+(O\text{-}O)+(O\text{-}O).$$

The powerful oxidizing properties of ozone may be accounted for by supposing that the three atoms of oxygen are so loosely combined that, when it comes in contact with an oxidizable substance, one of the atoms combines with this substance, the other two going to form a molecule of oxygen.

PROTECTION FOR IRON.

An alloy which is stated by C. Marshall, of Philadelphia, to be especially valuable in coating sheet-iron, spikes, nails, etc., which is not only cheap, but will allow of a good polish being given to the articles so coated, may be made by melting together eighty-five parts of lead, five of tin, five of copper, three of zinc, and two of antimony. The iron may be coated in any of the known methods used for tinning, galvanizing, or zincking iron. If a polish is not required, the zinc and antimony can be left out and replaced by lead.

THE PASSAGE OF GASES THROUGH VEGETABLE COLLOIDAL MEMBRANE.

THE experiments of M. Barthélemy lead to the conclusion that the natural colloidal surfaces of vegetables have, for carbonic acid, an admissive power which is from thirteen to fifteen times more considerable than that for nitrogen, and from six to seven times greater than that of oxygen. These experiments, proving the dialysis of carbonic acid through the cuticle of leaves, are of the same nature as the investigations of Dutrochet on membranes and aqueous solutions to determine the endosmose by the cellules. In a word, cuticular respiration appears sufficiently proved by the presence of this membrane on all the organs.

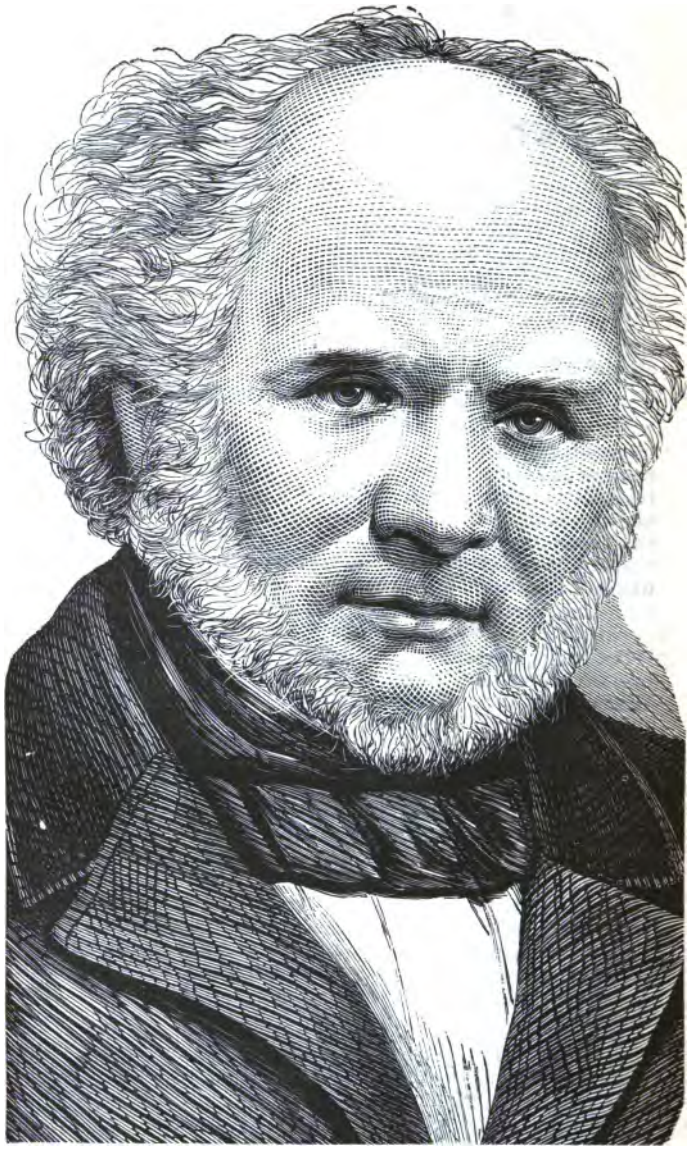
PURIFYING QUICKSILVER.

MERCURY, when being manufactured, frequently becomes foul from the mixing with it of unreduced cinnabar, the soot of the material employed in reducing it, and other impurities; but it is stated by Messrs. Randol & Wright, of New-Almaden, Cal., that, by treating it under agitation with heated water and alkaline matter, the foreign matter will unite with the water, etc., allowing the mercury to be drawn off clean and bright.

TREATING GOLD AND SILVER ORES.

A NEW process for desulphurizing and chlorodizing gold and silver ores without previous roasting, practiced by Joseph Kallmes, of San Francisco, is as follows: Place the previously pulverized ore in a vessel, and moisten it with water, in order to render the chlorination of the mass more active. Then inject chlorine gas or an aqueous solution of chlorine until the ore has been saturated, and introduce dry steam or hot air in order to expel the excess of chlorine, which will leave the metals in the form of chlorides, and free from sulphur. Metallic iron is now introduced into the pulp and allowed to remain until the chlorides thus formed are decomposed, thus leaving the metals in a suitable condition to be readily amalgamated. By this process, it is stated, a higher percentage of the precious metals can be extracted than has ever heretofore been obtained by raw amalgamation.

BŒTTGER'S PORTABLE INK.—The author saturates several sheets of paper with aniline-black, and presses them together into a compact and portable mass. For writing, it is merely necessary to tear off a piece of this paper, and steep it in a little water.



JOSEPH GILLOT FOUNDER OF THE STEEL-PEN INDUSTRY.

TECHNOLOGY.

MANUFACTURE OF FILES.

THE manufacture of files has hitherto been almost wholly monopolized by England, but the goods now made in the United States are rapidly driving the English article out of market. Several establishments on this side the water are now turning out files in large quantities, and of superior quality. Among these we may mention the Chicago File-Works.

The company use both English and American steel in their operations. The former, being of a more uniform quality, is used in files of the finest grades, and those which are required for the hardest work. Files from three inches to thirty-six inches in length, embracing every kind, form, and cut known to the trade, are made, the prices running from 84 cents to $35 per dozen. The company is now using eighty tons of steel annually in its business, and manufactures 3500 dozen files of all grades during that time, the monthly pay-rolls aggregating $1500.

After the piece of steel which is to be made into a file has been shaped under a tilt-hammer, it is annealed or softened, so that it can be cut. The ordinary mode of performing this operation is to place the steel blanks in a brick oven, and heat them to a cherry-red heat. When the fire has been maintained sufficiently long to accomplish this purpose, it is allowed to go down, and every aperture by which air can enter the oven is carefully closed, and the mass allowed to cool gradually, which requires from four to six days. After the annealing process is completed, the blanks are straightened and then carefully ground, to make as smooth and even a surface as possible, that they may be cut with regularity and furnish the least possible impediment to the easy manipulations of the chisel.

The cutting of the teeth is performed by workmen sitting astride a saddle-shaped seat, in front of which is a firm and solid stone bench, upon which is an anvil of iron, to which the blank is secured by straps passing over each end and under the workman's feet, very like the manner in which a boot is held on the knee of a shoemaker. The cutter then takes in his left hand a chisel made of the very best steel, and in his right a hammer of peculiar shape, the handle of which is fixed at such an angle that the operator can, while making the blow, pull the hammer toward him. If the file be flat, the cutter places the chisel upon it at an

angle—the top of the cutting instrument pointing from him—and with one blow of the hammer cuts an indentation or furrow completely across the face of the blank in an oblique direction. The metal displaced by this operation is not removed, but is thrown up toward the cutter, having a sharp cutting edge on the furrow side. He then moves the chisel toward him, sets it upon the blank, slides it back to the ridge thrown up by the last blow, and cuts another tooth. This is continued until the blank is full. The rapidity and accuracy with which the teeth are cut and the dexterity used in handling the chisel and hammer are curious to see, and while it would seem that the cutting is the principal part of the expense in making files, it is in reality the most insignificant. An expert cutter will put the teeth on a common single-cut mill file in about a minute. In making a cross-cut file, the second cutting is performed as the first, only the second furrows cross the first obliquely. Files for wood are usually cut with a triangular-pointed punch instead of with one having a flat edge. If the file be round or half round, it is cut with a chisel, but as a straight-edged cutting tool can only make a short indentation upon a convex surface, it is necessary to go round the file by degrees, making several rows or ranges of minute cuts contiguous to one another. The cut, it will be seen, is a triangular groove of peculiar shape, and its formation requires a skill and practice both in the handling of the hammer and chisel. The strict parallelism of the cuts can only be brought about by a practiced hand and eye, since no guide or gauge is used in the operation. Upon a half-round file ten inches long it is possible to put 20,000 chisel cuts, each one requiring a separate blow of the hammer.

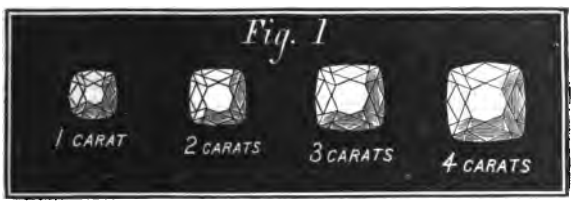
After being cut, the files are retempered, and on this process depends the value of the file. They are taken by the handle-end, after being thoroughly dried, in a pair of tongs, and dipped in a crucible filled with melted lead, and allowed to remain until they are as hot as the lead, when they are taken out and dipped in a bath of water containing salt and other ingredients that give the highest temper. Different manufacturers use a different bath, and each one supposes, probably, that his own produces the best results, and keeps its formation a secret. After hardening, the files are scoured with a brush dipped in water mixed with sand and charcoal, and then thoroughly washed to remove any of the saline particles with which the file came in contact in the tempering bath, and are dipped in lime-water for the same purpose. They are finally dried and oiled, and wrapped in papers for sale. (109)

DIAMOND-CUTTING IN NEW-YORK.

DIAMOND-CUTTING is an art—not merely an industry, requiring that certain degree of deftness of manipulation which, after a few years of apprenticeship, is readily attained in nearly every mechanical operation, but—a fine art in the full sense of the term. It is labor which calls not only for an exquisite refinement of manual dexterity, but an unerring judgment, to be gained only by hard study and constant practice, extending perhaps over a lifetime.

The art, from time almost immemorial, has been confined to the celebrated lapidaries of Amsterdam, Holland, whither the rough gems were forwarded from all parts of the globe: within a comparatively recent period, the practice of the art has been commenced in this country; one of the most effective establishments being that of the New-York Diamond Company.

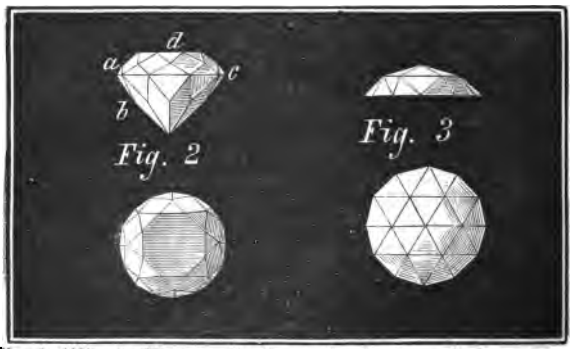
We recently were enabled to visit this establishment, situated in a small building in Fifteenth street, a few steps from Union Square, in this city, and there to follow the interesting operations which we are about to describe. As, in all descriptions, general explanations are first in order, we were at the outset informed that the business is divided into three entirely distinct branches—cleaving, cutting, and polishing. Also, that each class is a separate art, and that the workman finds the attainment of any one sufficient labor for the balance of his existence without troubling himself about the others. Hence, no one man can carry a stone through all the manipulations. A cutter can not cleave, nor does a polisher know aught about cutting; and even further, a polisher or cutter of a brilliant can not produce a rose diamond, and *vice versâ*; so that, in fact, each individual has his specialty, and there stops his knowledge.



NATURE OF THE DIAMOND.

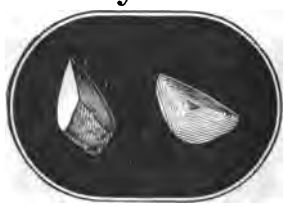
The diamond itself, as all are aware, is nothing but carbon, a combustible body. It is crystallized mostly in the shape of an octahedron (two four-sided pyramids united at their bases) or rhombic dodecahedron, the latter being

the commonest. In its black form—as used for stone-drilling or sawing—it is the hardest known substance, and in this state differs from the jewel, which has foliated passages parallel to the faces of figure, in which directions it may be split. An idea of the relative sizes, proportionate to the weight of the stones, may be gained from Fig. 1, representing diamonds of 1, 2, 3, and 4 carats.



The brilliant (Fig. 2) displays the lustre of the stone to the greatest advantage, and is described as obtained by two truncated pyramids united together by one common base, the upper pyramid being much more truncated than the lower. *a* is the crown and *e* the collet, the two principal divisions formed by the girdle *c*. *d* is the table, and the opposite side below, the culasse. The faces are called facets, and, including table and culasse, may number sixty-

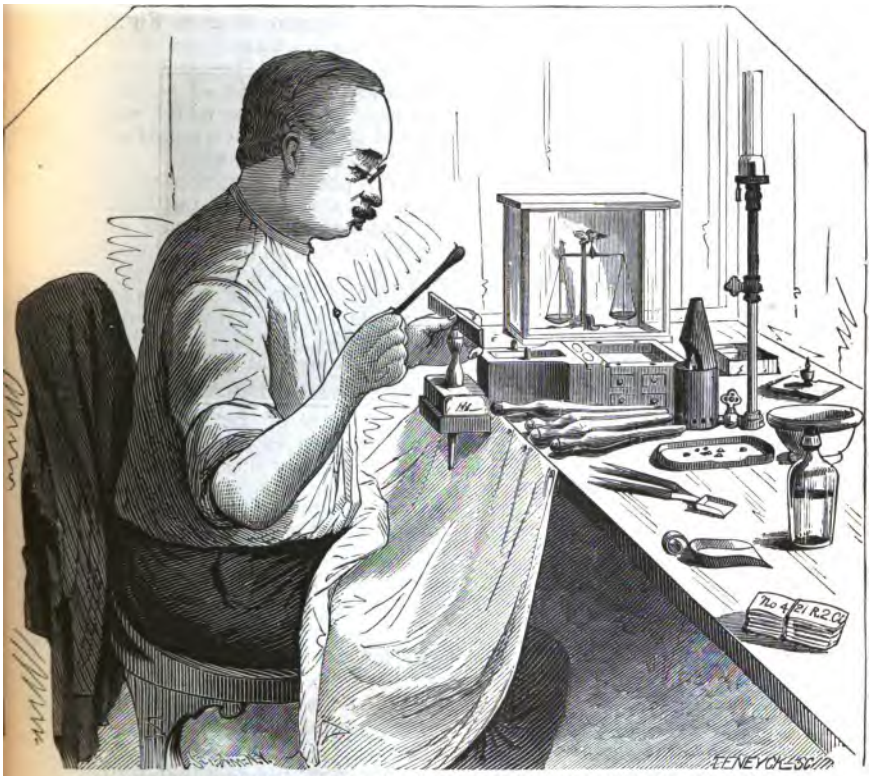
Fig. 4



THE ROUGH DIAMOND.

four. The rose diamond (Fig. 3) has a crown but no collet, that is, one side is flat; and it is usually made from stones and fragments which would not, without loss, form good brilliants. Then there are table diamonds, which are flat and have little lustre, and bastard diamonds, or those of mixed shapes.

In the accompanying engraving (Fig. 4) is represented an enlarged section of the rough gem, showing the grain, along which it may be as cleanly cleft as a piece of wood. The resemblance to the latter substance is increased by



DIAMOND-CUTTING IN NEW-YORK.—THE CLEAVER OR KLOVER.

the fact that there are so-called knots, which cause a conchoidal instead of a straight clean fracture.

THE CLEAVER.

This much imparted by way of preface, we were conducted to the apartment occupied by the cleaver, or *klover*, as he is called in Holland. This artist, we were informed, must possess a greater degree of skill than any other workman. So difficult is his labor, that probably there do not

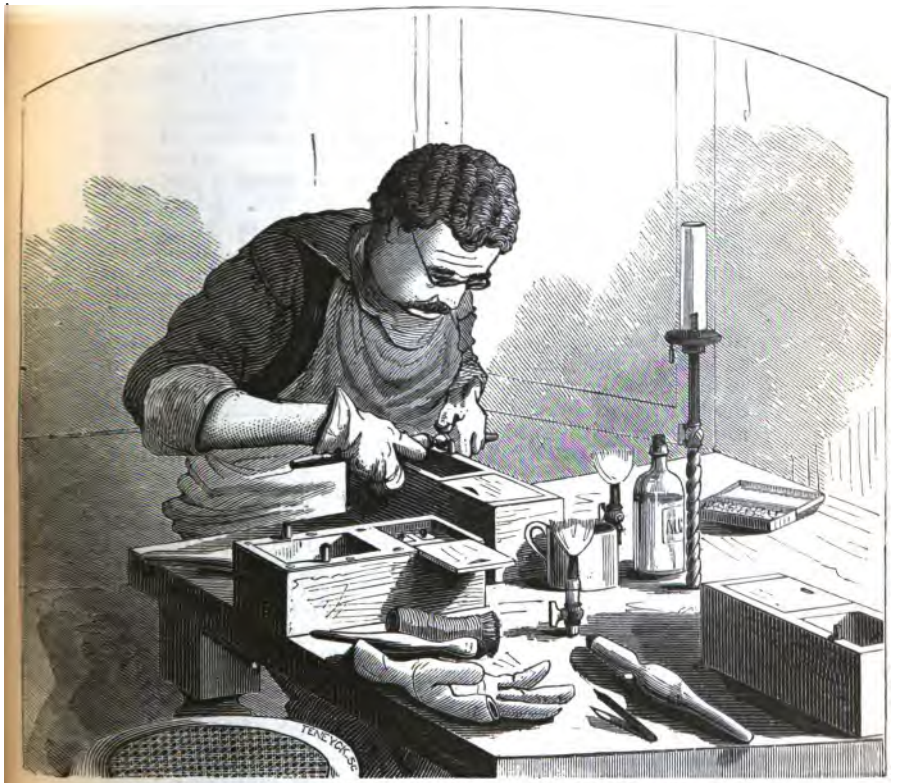
exist twenty-five cleavers to every five hundred polishers and cutters in the world. The *klover* in Holland is taught from boyhood, and is usually the son of the owner of the establishment, outside parties being rarely instructed. On a small table in front of the workman was a little box divided into two compartments, the furthest containing a covered tray for the reception of stones. The other division was made deeper and had a false bottom, being finely perforated. Also on the table were a number of sticks like spindles, which, with a couple of knives, (to which we shall presently allude,) a metal rod for a hammer, a pair of scales, and a spirit-lamp, constituted the entire kit.

Opening a number of little envelopes, each marked with a full description of its contents, the cleaver first put into our hands a quantity of rough stones. They seemed of irregular shape and varied in size, from that of a pin-head to a large pea. Some pieces were quite flat, and closely resembled mica. Selecting a diamond from the heap, the artist glanced at it a moment, and then secured it in a knob of cement (brick-dust and rosin) on the end of one of his spindles. Taking a fragment of a stone that had already been operated upon, he fastened it in a second spindle in similar manner. Next, with an implement in each hand, he brought the diamonds together, steadying the shanks of his tools against two metal projections on the edge of the box before him. Applying the second diamond to the rough gem, with a quick grinding motion he rapidly cut a notch in the latter; it was hardly the work of an instant, but the line was perceptible.

At this point our curiosity prompted us to ask explanation, and suspending his labor, the cleaver showed us that there were flaws in the stone which had to be cut off, and besides, other pieces to be removed to give the gem its proper shape; so that probably, of the whole rough jewel, hardly one half would be available. We looked wisely for the flaws, but utterly failed to detect them, a fact not to be wondered at when we were informed by the artist that this ability constituted an important part of his art. "Indeed," he observed, "I have to know the structure of a diamond far more intimately than a physician that of the human body." As hardly any two stones are alike, and no rule can be laid down for the work, some idea may be gained of the consummate skill which enables a man to pick up a tiny fragment, glance at it once, and instantly detect not only flaws or streaks, but where they are located, in the heart or on the surface, to make up his mind exactly what microscopic pieces must be removed, their size, and how they may be cut to turn them to best account, and, finally,

how to so divide the stone as to produce the best color. And all this so quickly that, although we saw half a dozen stones operated upon, we asked afterward, When the workman had examined them? We had not noticed the single swift look given at each, as one after another was split by the artist as he continued his explanations.

Placing the spindle containing the gem upright before



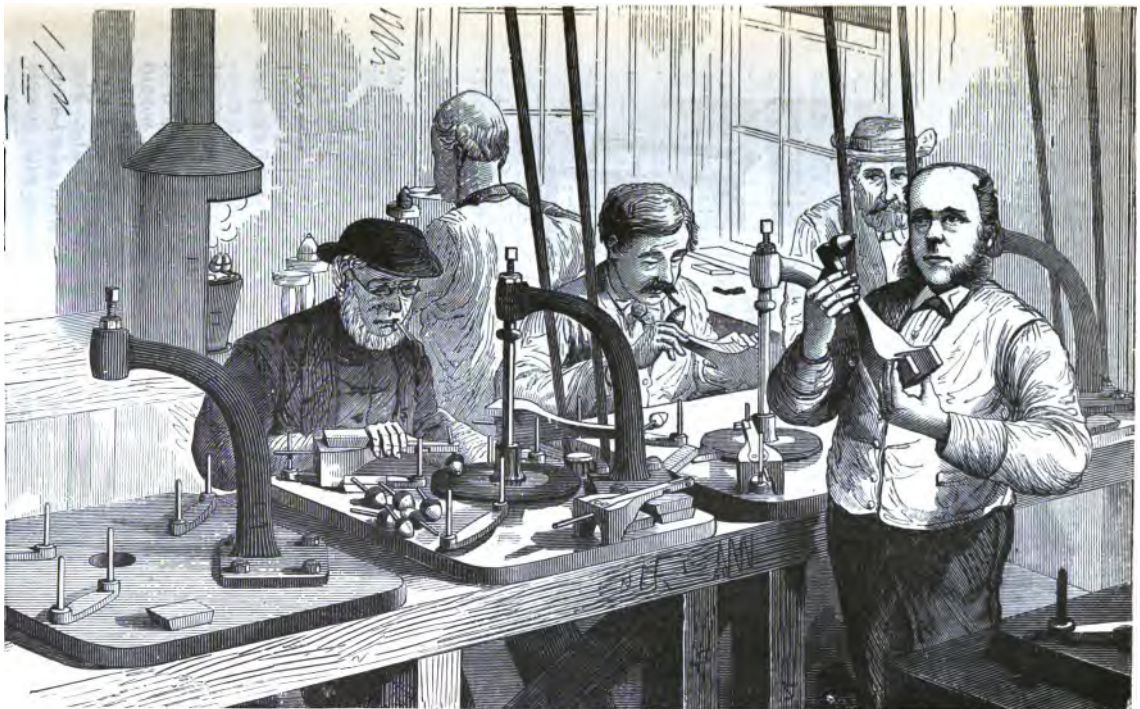
DIAMOND-CUTTING IN NEW-YORK.—THE CUTTER OR SNYDER.

him, the operator placed one of his knives directly over the cleft. The knife used was nothing more than a piece of steel, perfectly flat, with a square edge, and about six inches long. It is ground blunt purposely, for if it were keen, the hard stone would quickly turn the edge. Tap-

DIAMOND-CUTTING IN NEW-YORK.—THE SETTER.

ping the back of the blade lightly with his iron rod, the artist split off a fragment, and then, melting his cement and removing the parts, showed us a clean smooth cut. (See Fig. 4.)

"But is not this a very risky performance?" we almost involuntarily exclaimed. "Suppose that you make a mistake?" The workman smiled superior, and explained that such is hardly possible, though he admitted that it would be a very easy matter to halve the value of a gem by a single false stroke. Imagine a $5000 diamond—and that is not a large one—thus treated; $2500 irretrievably lost by a single tap of the hammer! But then, with good-sized stones, the work does not seem so difficult as with jewels no larger than pin-heads, so small indeed that, in some cases, they number as many as 300 to the carat in the



DIAMOND-CUTTING IN NEW-YORK.—THE POLISHERS. (93)

rough, or 400 finished. Of course nothing is wasted; the dust that falls through the false bottom of the box, we shall find again in the hands of the polishers, while the odd scraps are cut into rose diamonds, or the little sparkling grains used for inlaying initials and similar fine work in gold jewelry.

THE CUTTERS.

Our artist has graphically depicted the cutter at his work in the engraving. The same form of box used by the cleaver is before him, and the diamonds are fastened by cement, as before, in the ends of spindles. The cutter's labor is purely "diamond cut diamond." The stone to be cut is held in its setting firmly in the left hand, while the cutting piece is moved by the right. Both gems are of course affected by the mutual abrasion, but the attention of the workman is directed to but one. Very slowly the faces are ground away; no measurements are taken or angles calculated. The eye is the only guide, and it seems to be a faultless one. As soon as the first stone is finished, the diamond used for cutting it is operated upon, so that diamond No. 2 is, in turn, cut by No. 3, this by No. 4, and so on. Again the gems were handed to us for examination; all their mica-like sheen was gone; and, were it not for their form, they presented no different appearance from rough quartz pebbles. The friction dulls them, for they are ground together with considerable force, the workman being obliged to protect his hands by thick coatings against the rubbing action of the tool.

POLISHING THE DIAMOND—THE SETTER.

The polishing operation next claimed our attention; and ascending to an upper story, we found the polishers or *slypers* at their work, each man with a machine before him, as represented in the large engraving on page 177. In addition to these workmen is the setter, and with him we have first to deal. At one side of the room is a small charcoal furnace, in which a number of metal acorns seemed to be roasting. Each of the latter consisted of a copper cup about an inch and a half in diameter, provided with a stem of stout wire of the same metal and filled with plumber's solder. As these rested on the glowing coals, the setter occasionally tried the hardness of the solder with his forceps until the metal became of about the consistency of putty. Quickly removing an acorn, or, to use the technical name, a "dopp," from the fire, he placed it upright in a small stand. Then he fixed a diamond exactly in the centre of the plastic metal, and, with his fingers, coolly moulded the latter in conical shape around it. Burn-

ing seemed to have no terrors for him, and although, when the dopp was plunged in water, it hissed at a great rate, the hand of the workman showed no effect of the heat. Each brilliant, large or small, has to undergo this operation once for each facet ; that is, the setter must reset it so that every one of its facets in succession may be exactly horizontal and outside the holding metal, in order that each face may receive its proper polish—an operation requiring no small amount of delicacy and skill.

THE POLISHERS.

Again referring to the large engraving on page 177, the polishers were seated before long tables, on which were swiftly rotating horizontal disks fastened on vertical spindles, the lower ends of which revolved in anti-friction steps. The disks, we were told, revolved at the rate of 2000 turns a minute, and yet the bearings kept perfectly cool. The machine is an invention of Mr. Herrmann's, and an improvement upon the old apparatus used in Amsterdam.

The disks or *shives* are circular plates of a composition containing both iron and steel, and are made and turned in the establishment. They are ground in lines, at an angle from centre to circumference, so as to hold the oil and diamond-dust used in the polishing operation.

Three diamonds, set as above described, are ground at once, by each polisher. The stem of the dopp is fastened in tongs or clamps, the extremity of the latter being supported by legs an inch or so high. Two thirds of the dust ground off in the cutting is allowed to polish each diamond, and this, mixed with oil, is applied to the stone by the quills which the men seemed to be phlegmatically chewing. The adjusting of the gem on the disk requires wonderful accuracy in order that exactly the proper facet be ground and no more ; for the slightest mistake might cut away an angle and produce serious damage to the stone. The reader will share in the astonishment we felt on learning that this extremely delicate work was done by feeling. So sensitive is the touch of the artist that he tells by pressing on the stem of the dopp exactly whether it lies true against the shive or not, and by his fingers adjusts the stone over incredibly minute angles and distances. This goes on until each facet is brought to the requisite brilliancy. Standing by one of the machines, we saw, as the diamond was removed from time to time from the disk, the bright spot on its dull face gradually enlarge, as heavier weights were put upon the tongs to press the stone with increased force against the shive. Sometimes

the gem defies all efforts, the hard outer coating refuses to yield, and then it is passed from hand to hand, and for weeks each workman tries to conquer it. Sometimes they fail; at others, a bright spot at length appears, and the difficulty is over.

It is to this portion of the establishment that injured stones are sent for repairing. We were shown a number of diamonds that had been through the Chicago fire. They had become intensely heated and then suddenly cooled. A white hard film had formed over them, necessitating as careful re-polishing as the unfinished gem. We were told that it is a common fault among jewelers to thus hurt the stones during the process of setting them. The difficulty can be easily avoided by allowing the diamonds to cool gradually instead of plunging them at once into cold water. It is the sudden transition and not the heat that does the injury.

ABOUT THE WORKMEN AND THEIR PAY.

Our examination here concluded, for polishing is the last process. The workmen, numbering thirty-five in all, we learned, were all Israelites, and, with the exception of the cleaver, were paid by piece work. Their wages reach from 60 to 200 dollars a week, depending on the skill and experience of the artist. The greater number of carats manipulated, and the more diamonds there are to the carat, the higher the price paid for the work. The establishment is necessarily organized with great strictness, and every diamond is weighed, registered, and fully traced throughout its entire course. Large and valuable stones, before being operated upon, are made the subject of a consultation between the head of the company, the cleaver, chief cutter, and chief polisher. Each gives his view, and thus the question of shape, color, etc., is carefully determined.

The diamonds are principally imported hither from Brazil. South-African gems have caused no very marked effect in the market. They are fine, but, it is stated, more difficult to cut than those from South-America.

Recent advices are to the effect that a huge diamond has been discovered and brought from the Cape. It weighs 288⅜ carats in the rough, and when cut will be half as large again as the world-renowned Koh-i-Noor.

PROSPECTS OF THE ART.

We see no reason why the art which we have described should not grow in this country to be an important branch of national industry. To Mr. Herrman, now the President

of the New-York Diamond Company, a corporation of wealthy gentlemen, founded by himself, belongs the credit of its establishment among us, and the consequent enabling of the artisans of the United States, who may be instructed in his *atéliers*, to compete with and successfully rival the monopoly which, for centuries, has maintained an exclusive and undisputed supremacy in the old world.

THE USE OF DIAMONDS IN DRESSING STONE.

THE Gear Stone Machine Company, of Boston, have recently introduced a newly-invented machine for working stone, which surfaces, makes straight and irregular mouldngs, panels, letters, upon edges and faces, carves, and in ifact operates upon the hardest rock with as much facility and with nearly the same degree of rapidity, that a steel cutter penetrates a wooden board. The apparatus consists in simply a horizontal arm working freely from a standard, and jointed at the middle. Rotary motion is transmitted by belting to a vertical shaft at the outer extremity, to which the cutting instrument is attached. Suitable appliances are provided for regulating pressure, vertical movements, etc., of the tool, and the table is made capable of adjustment to any desired height. The chief merit and efficiency of the machine lie in the use of carbons or black diamonds and their arrangements in the cutting tools. The latter are made of steel, and the diamonds are so secured in them as to conform to the shape of the style of moulding required. The operation consists in placing a wooden pattern upon the stone and clamping both firmly to the table. The workman then grasps handles above the cutter, and thus causes the latter, while swiftly revolving, to follow the lines of the model.

Trials conducted in our presence fully satisfied us as to the practical success and utility of the invention, as we saw the instrument cut mouldings in stone, in a few seconds, which would take a man some hours to complete. The most refractory substances, such as hard granite, seem to present no more obstacle to the passage of the tool than the softest limestone, and the work is turned out finished with even more smoothness than would be possible by hand labor. For raised mouldings, edge cuttings, and surfacing, the machine develops equal efficiency. There can be no question but that this is one of the most important applications of the diamond yet discovered, and its general introduction must tend to largely diminish the now great cost of preparing and dressing stone for building purposes.

SILVERING GLASS.

FOR a long time, aldehyde has been employed in the glass silvering process suggested by Liebig; but some difficulties of manipulation have led practical men to prefer other reducing agents. R. Siemens has modified the operation and greatly simplified the reduction of the silver. Dry ammonia gas is passed through aldehyde to produce aldehyde ammonia; 2.5 grammes of aldehyde ammonia and 4 grammes nitrate of silver to 1 litre of water is the proper proportion to take. The nitrate of silver and aldehyde ammonia are separately dissolved in distilled water, mixed, and filtered. The object to be silvered must be thoroughly worked to free it of fat, and if it be a globe or bottle, the liquid is poured in as high as it is desired to form the deposit. As soon as the heat, which must be applied, shows 50° C., the separation of the silver begins and soon spreads itself over the whole surface. At first, when the coating is very thin, it looks dark, but soon assumes a metallic lustre; when it is a brilliant white, it is time to remove the fluid contents, as the mirror is apt to be injured by too long contact with the aldehyde. Flat objects are laid upon the mixture in the usual manner. In Germany, where aldehyde ammonia can be purchased at a reasonable cost, this process is highly prized. By making his own salt, in the manner described above, the chemist in this country can also avail himself of the method. The simplicity of Siemens's process certainly commends it to favor.

PLATING WITH ALUMINUM.

ACCORDING to John A. Jeancon, of Newport, Ky., metal surfaces may be plated with aluminum by the following process with great facility: Dissolve any desired quantity of a salt of aluminum, such as the sulphate, muriate, nitrate, acetate, cyanide, etc., in distilled water, and concentrate the solution to 20° Beaumé, (at 50° Fahrenheit,) in a suitable vessel to hold the articles to be plated. The battery to be used should either be four pairs of Smee's zinco-platinum, or three of Bunsen's zinco-carbon, with the elements connected for intensity, and a plate of aluminum attached to the negative wire. The solution should be slightly acidulated with its appropriate acid, heated to 140° Fahrenheit, and kept at that temperature during the operation.

CUPRO-AMMONIUM AS A SOLVENT FOR CELLULOSE.

CUPRO-AMMONIUM, or ammonio-cupric oxide, is a solution of the oxide of copper in ammonia. If we allow aqua

ammonia to trickle slowly over copper turnings, some oxide of copper is formed, which dissolves with an intense blue color in the excess of ammonia. Leaving ammonia for some time in contact with the copper, and occasionally shaking the vessel to secure access of air, will also yield it. Perhaps a more rapid way is to cautiously add ammonia to a solution of sulphate of copper, then to filter off the supernatant liquid from the precipitated oxide of copper, and to dissolve the fresh oxide in ammonia. It ought to be borne in mind that the cupro-ammonium reagent must be concentrated, as the dilute has little effect. As this is a solvent for cellulose and not for all sorts of impurities, the various substances to be tried must first be freed from extraneous matters. As much of our paper is weighted with French-chalk, *terra alba*, and sulphate of baryta, these mineral compounds may interfere with the experiments. Pure linen paper, such as is employed in the manufacture of gun-cotton, ought to dissolve in cupro-ammonium very readily. Sea-weed, grass, straw, ramie, etc., would require treatment with caustic soda to dissolve out the silica and other impurities. Peat, being nearly pure carbon, would not be readily acted upon. To waterproof the paper, only the surface is acted upon, and the sheets are heavily pressed between rollers. Instead of trying tungstate of soda to render wood and paper fireproof, it would be well to experiment with soluble glass, as being a much cheaper article.

It must not be forgotten that chloride of aluminum is also said to be a solvent for cellulose, and there may be cases where this reagent would serve a better purpose than the more expensive copper salt. Sulphate of aniline yields a yellow color with wood fibre, and this reaction may be employed for the detection of the adulteration of linen paper by wood. There are doubtless many uses to which it would be possible to apply precipitated cellulose, and we trust that our correspondents will persevere in experiments upon the cupro-ammonium solvent. (83)

MANUFACTURE OF WHITE-LEAD.

EDWARD MILNER, of Warrington, England, manufactures white-lead by the following process: Mix with finely-ground litharge a solution of the chlorides of sodium, potassium, or ammonium, and keep the mixture thoroughly agitated for a few hours. Next pass a current of carbonic acid and violently agitate the compound until it no longer gives an alkaline reaction, when the product will be found to be carbonate of lead of great body and capacity, which only needs washing (to free it from salts) and drying, to be ready for use.

TO CEMENT GLASS ON BRASS.—A cement is used by Puscher which is particularly serviceable, says the *Druggist's Circular*, in attaching the brass mountings on glass lamps, as it is unaffected by petroleum and all of this class of burning-fluids. It is prepared by boiling three parts of rosin with one part of caustic soda and five parts of water, thus making a kind of soap, which is mixed with one half its weight of plaster of Paris. Zinc-white, white-lead, or precipitated chalk may be used instead of the plaster; but when they are used, the cement will be longer in hardening. It has a great adhesive quality. The possibility of dissolving it to remove the mountings will recommend it to many persons.

FIRE-PROOFING WOOD.

1. The wood is twice painted over with a hot saturated solution of 1 part of green vitriol and 3 parts alum. 2. The wood, after drying, is again painted with a weak solution of green vitriol, in which pipe-clay has been mixed to the consistency of ordinary paint. This coat is renewed from time to time.—*F. Sieburger.*

NOVEL SHOE-PEG.

C. KENISTON, of Somerville, Mass., proposes to unite leather work, and particularly the soles of shoes, by means of small staples having their points beveled off on their inner sides, so that when driven in, the points will spread, thus passing through the leather obliquely or on a curve, and if driven far enough, will clinch against the iron last.

SOFTENING AND TOUGHENING WOOD.

G. W. SWAN, of San Francisco, states that if blocks of wood intended to be used for cutting veneers are first boiled or steamed in a solution of ammonia and borax, they will not only become soft and easy to cut, but the veneers formed from them will retain their flexibility for an indefinite length of time.

PRESERVING LUMBER.

JOHN OLIVER, of Toronto, Canada, treats lumber to a bath of steam, at a low pressure, which has passed through a vessel containing sulphate of zinc and alum.

LINING BARRELS.

INSTEAD of taking glue which has already been dried and hardened, and then reducing it to a liquid state a second time, E. M. Leggett, of New-York, proposes to line oil-barrels with the glue when it is first in the liquid form, before it has been hardened, and thereby save the expense of the usual drying and subsequent liquefaction of the ordinary process.

VULCANIZED WOOD.

LEVI HEYWOOD, of Gardner, Mass., makes a whip-stock nearly equal to one of whalebone by filling the pores of a suitable piece of wood or ratan with a solution of rubber or gutta-percha, and then vulcanizing the same.

ARTIFICIAL EBONY.

THIS is prepared on a large scale by grinding to powder 60 parts of charcoal obtained from sea-weeds, previously treated with dilute sulphuric acid and dried, and mixing it with ten parts of liquid glue, five of gutta-percha, and two and a half of india-rubber, care having been taken to mix the two latter substances with coal-oil tar to render them gelatinous; then ten parts of coal-tar, five of pulverized sulphur, two of pulverized alum, and five of powdered resin are added, and the mixture heated to 300° Fahr. After having been cooled, a substance is obtained which is equal in many respects to genuine ebony wood, but far less expensive, and capable of receiving a finer polish.

GLASS BARRELS FOR PETROLEUM.

So much loss has occurred from evaporation and leakage in the transportation and storage of petroleum, and its products—benzine and gasoline—that it is proposed to make barrels of glass, sufficiently heavy to stand the pressure and usage. These, although much more costly at first, would never wear out, and could be cleaned and used for any other fluids indefinitely. An inventor has already obtained a patent for a thick piece of glass inserted into one head of a barrel, and on the part next the bung-hole, to allow the quantity within to be viewed by the buyer.

CONVEYANCE OF OIL IN PIPES.

THE heavy charges for railway freights on crude oils, between the oil regions and the Atlantic seaboard, have led to the preliminary examination of the feasibility of using iron pipes.

The estimated distance from Titusville, Pa., to Philadelphia, allowing 40 miles for undulations of the surface, is 300 miles. The highest elevation required to pump the oil is 1300 feet. The summit could be reached by means of five pumping stations, each throwing the oil 300 feet high, and driving it eight miles. A six-inch cast-iron pipe is proposed. The capacity for delivery would be over 1,000,000 gallons, or 20,000 barrels per day. The estimated cost is $3,500,000, and the estimated net profits about the same amount, or 100 per cent on the cost.

The piping for crude oil already in operation in the oil districts of Pennsyvania has a total length of 675 miles,

inside bore 2 inches, and gathers the oil from the following points to various places of shipment on the Alleghany Valley Railroad:

	Bbls.
Emlenton Pipe Company, from St. Petersburg to Emlenton—capacity per day	1,000
Antwerp Pipe Company, from St. Petersburg to Fullerton—capacity	2,500
Mutual Pipe Company, from St. Petersburg Dist. to Milford, Foxborough, and Clarion—capacity	10,000
Union Pipe Company, from Parker's Dist., etc., to Parker's Landing—capacity	6,000
Fairview Pipe Company, from Argyle, Petrolia, etc., to Brady's Bend—capacity	5,000
Butler Pipe Company, from Grease City to Butler—capacity	1,200

(39)

COMPOSITION FOR GAS.

W. H. STERLING, of San Francisco, proposes the manufacture of gas by distilling in a retort blocks made as follows: To crude petroleum or coal-tar add, in proportion to its richness or gravity, ten to twenty per cent of water, and from one half to two per cent of caustic lime. Thoroughly agitate the whole to produce an emulsion, and then mix sufficient finely-pulverized ashes to make a plastic mass, which may be moulded into blocks suitable for placing in a retort.

MANUFACTURE OF GAS.

A NEW process of purifying gas, devised by William H. St John, of New-York, consists in condensing in the hydraulic main the vapors brought with the gas from the retorts and conveying the liquid into the lower part of a chamber in the upper part of which is a horizontal partition, from which dip-tubes are suspended. An exhauster draws the gas from the main and forces it through the dip-tubes in the chamber into the liquid below, from whence it passes into a tank and from thence to the gasometer. The chamber above referred to may be provided with an adjustable valve to regulate the amount of seal, or a syphon may be added to allow the condensed liquid to keep at the desired level. By this process it is claimed that no water is required other than that evolved from the coal, and that the usual chemicals for purification are not required.

DYEING OF FELTED FABRICS.

IN making felted fabrics of a mixture of animal and vegetable fibres, it is found difficult to dye them evenly, as the vegetable fibre does not take the dye equally with the remainder. To overcome this difficulty, J. T. Waring, of Yonkers, N. Y., proposes to neutralize the vegetable matter by subjecting the felted fabric to an acid bath of from 6° to 12° Beaumé, and then washing to remove the acid, after which, it is stated, the fabric will dye an even tint.

PREPARATION OF LIGHT DRYING-VARNISH.

TWENTY-FIVE pounds of pure linseed-oil are poured into an enameled iron pot, which holds about forty pounds weight; the pot is then placed on a moderately strong charcoal fire, and the linseed-oil heated for about half an hour to the boiling-point. In the mean time four ounces of pure oxide of manganese are to be rubbed down in linseed-oil. This mass is then put into a small vessel provided with a spout, and poured in drops into the boiling linseed-oil, while being gently stirred with a wooden spatula.

During the rising and effervescence of the heated oil, the dropping in of the manganese preparation must stop.

As soon as the oil has settled, the dropping in is continued to the last. The vessel is washed out with linseed-oil, which is poured into the boiling oil. The varnish is now boiled slowly for an hour, but if a stronger or more quickly-drying varnish is desired, it should be boiled for half an hour or an hour longer.

The finished varnish is then removed from the fire, covered with a clean plate, and left to rest for about twenty-four hours, then carefully poured off into clean vessels. The sediment and other residue are generally used for ordinary ground colors.

The pure linseed-oil varnish poured into glass bottles can be perfectly bleached by selecting a suitable spot where the sunlight and moonlight penetrate. According to Dr. Gromann, moonlight bleaches quicker than sunlight. The clear bleached linseed-oil varnish is used only for the finest white oil and lac colors, and for dissolving the copal lacs, as well as a drying medium for all fine oil-colors.

PARAFFIN FOR STOPPERS AND LABELS.

PROFESSOR MARKOE states that the practice in Boston is, not to varnish a label for acid bottles, but to use paraffin instead. They had applied it to a large number of bottles in the college laboratory, and it answered perfectly. The only thing necessary was to brush the paraffin on as hot as possible, so as to get a thin even coating; it looked as well as varnish, and stood a great deal better. It saved a good deal of trouble in sizing and varnishing, and five minutes after the bottle had been brushed it was ready for use. It has been stated that the use of paraffin could be extended a great deal further; that instead of sealing the tops of bottles—sample bottles of bleaching-powder, and for other purposes—it was very convenient to have a small porcelain dish with paraffin always ready, which

could be placed upon a lamp, and, as soon as it was warm, to dip the top of the bottle in it, and that gave as good a sealing as sealing-wax, or better, and caused very much less trouble. It had also been proposed to use stoppers made of solid paraffin for soda samples; but he did not like this, because they broke so easily. What Dr. Lunge had found to answer perfectly well was to rub some heated paraffin upon the stoppers in place of tallow. He found it a great deal cleaner, and answering in every way for this purpose.

A NEW THERMOMETER.

DR. HILLIARD has invented a clinical thermometer which shuts up like an ordinary pencil-case, and then goes into the vest-pocket. Thus, there is no separation between the handle or case and the thermometer itself. The latter therefore can not fall out, nor does it require so much trouble to put away after use. It has also the advantage of being increased to double its own length on opening it. The temperature consequently can be taken and read in positions in which it is not so easy to do it with the common pocket instrument. (103)

ZOPISSA.

THIS is essentially a paint composed of boiled linseed-oil, brown umber, lime-water, sulphate of copper, Prussian blue, copperas, burnt clay, calcareous silex, (whatever that may be,) litharge, asphalt, red-lead, gum animi, and turpentine. It was probably through mere modesty that the inventor stopped after adding these ingredients and did not continue through the drug-shop. The paint is no better and no worse than one containing an impure oxide of copper for pigment, and linseed-oil and asphaltum for the menstruum. It will no doubt protect the wood to which it is applied in sufficient quantities, from external action, so long as it lasts. (63)

COPPER BATH FOR METALS.

MESSRS. GAUDIN, MIGNON & ROUART, of Paris, state that wrought or cast-iron or steel articles may be readily and permanently coated with copper of any desired thickness by dipping the goods into a mixture of one part of dry chloride or fluoride of copper and five or six parts of cryolite, to whch may be added a "certain quantity" of chloride of barium to render it more fusible, melted in a crucible or carbon oven, and the articles when removed will be found coated with an adherent coat more or less thick according to the time of immersion.

PREPARATION OF FLOOR-WAX.

Two ounces of pearl-ash, 10 ounces of wax, and about half a pint of water are heated to boiling in a dish, which is frequently agitated, until a thick fluid mass is formed, from which, upon removal from the fire, no watery liquid separates out. Boiling water is now cautiously added to the mass, until no watery drops are distinguishable. The dish is again set on the fire, but its contents are not allowed to boil, otherwise myricin would separate out, 8 or 9 pints of water being added, little by little, with constant stirring. Coloring matter may be added, if desired.—*Nessler.*

A TENACIOUS COLLODION FILM

A COLLODION film of considerable strength may be prepared by making a concentrated solution of gun-cotton in equal volumes of ether and absolute alcohol, and adding to it a small quantity of balsam of copaiba. This collodion solution, when largely diluted with ether and alcohol, may be used for rendering linen and cotton fabrics waterproof.

NEW PLASTIC COMPOSITION.

IT is stated by H. E. Shepard, of New-Haven, Ct., that by mixing pounded fragments of mica with a proper proportion of shellac, a composition is made that, when moulded into suitable forms, will present the appearance of shell on the surface, and will be much harder and tougher than other compositions of which shellac forms the basis.

COTTON FOR COLLODION.

COTTON as usually prepared by the acid process is subject to become injured by lapse of time from the difficulty of entirely removing all traces of the acid. To overcome this defect, H. T. Anthony, of New-York, proposes to subject the cotton to the fumes of ammonia or other volatile alkali after the ordinary acid treatment and washing.

A RESINOUS EXPLOSIVE.

IT is stated by Alfred Nobel, of Hamburg, that a powerful explosive that may be safely handled, and one which will burn without exploding if unconfined, may be made by mixing nitrate of soda and resin, or their equivalents, with or without a little sulphur, with sufficient nitro-glycerine to form a stiff paste.

VENEERED LITHOGRAPHIC STONES.

IN order to utilize to the utmost the natural lithographic stones, Messrs. Moore and Bagger saw them into thin slabs (too thin to be used in the press by themselves) and imbed them in a block of artificial stone.

SELF-LIGHTING SIGNAL-LANTERN.

IN 1871, we described a signal-lamp, invented by Holmes, which, on immersion in water, was self-lighting, and produced a brilliant illumination. Its principle rests upon the use of phosphide of calcium, which, in contact with the water, develops spontaneously combustible phosphureted hydrogen gas. A German engineer has recently been experimenting with this lamp. A long tin tube, firmly closed, in which were contained 900 grains of phosphide of calcium, was kept afloat upon the water by being fastened to a piece of board. Before putting it into the water, the bottom of the tube was perforated to allow the water to enter, and the upper point cut off so that, on the entrance of the water, the self-lighting phosphureted hydryogen gas was developed. A flame, four or six inches broad and 24 inches high, lighted up the steamboat and pilot-boat, which had gone out four miles on the sea with a party to witness the experiments, so brilliantly that the vessels and men upon them were distinctly visible from the lighthouse at that distance. In a tolerably heavy swell the flame was preserved for three quarters of an hour, and appeared, at the distance of one or two miles, like a strong signal-fire. In the immediate vicinity, for a distance of 28 yards, the light was strong enough to allow of any work being done. For pilot and wrecking service, this signal-fire can be highly recommended.

The preparation of the phosphide of calcium can be accomplished as follows: In the lower part of a narrow deep crucible, a hole is drilled for the reception of the neck of a flask, which is luted into the aperture; a quantity of dry phosphorus is placed in the flask, and the crucible is filled with quicklime broken into fragments of about the size of a hazel nut; a lid is then luted upon the top of the crucible. Time having been given for the luting to become dry, the upper part of the crucible is raised to a red heat as quickly as possible by surrounding it with ignited charcoal, the lower part of the furnace having been filled with cold charcoal to prevent the heat from reaching the phosphorus too rapidly; the phosphorus becomes gradually volatilized as the heat reaches it.

If the heat be too high, the phosphorus distills over without combining with the calcium. The phosphide of calcium, when procured in this manner, forms an anhydrous mass of a dull red color, hard enough to strike fire with steel; it experiences no change in dry air or in oxygen at the ordinary temperature. At a high temperature, it becomes partially decomposed by oxygen, chlorine, or hydrochloric acid; in a moist atmosphere it slakes, emits

phosphureted hydrogen, and crumbles to a brown powder. The phosphide of calcium, in its insulated form, is decomposed when thrown into water; phosphureted hydrogen gas is evolved, which takes fire spontaneously. It is necessary to keep the preparation in hermetically-closed vessels. Where the phosphide is required to be attached to life-preservers or signal buoys, it can be inclosed in tubes which are stoppered with some salt that will dissolve off in contact with water. In case of a man overboard in the night, his position could be detected by the employment of floating grenades of phosphide of calcium thrown from the ship.

It has been stated that, by fusing magnesium filings and phosphorus together, a compound results which can be employed as a substitute for the phosphide of calcium in the evolution of phosphureted hydrogen gas. As magnesium can now be procured in considerable quantity, this method may be worthy of a trial. (83)

DYEING KID GLOVES.

THE dye solutions are brushed over a glove drawn smoothly over a wooden hand. In order to dye black, the glove is brushed after washing it with alcohol, dried and brushed with a decoction of logwood, left for ten minutes, and brushed over once more with logwood. After ten minutes, the glove is dipped into a solution of sulphate of iron and brushed afterward with warm water. If the color is not dark enough, add a little fustic or decoction of quercitron in the logwood bath. In place of the sulphate of iron, the nitrate may be better employed. When the glove begins to dry, it is rubbed with a little Provence oil and talcum, laid between flannel and pressed. It is then rubbed again with oil and talcum and drawn on a wooden hand. The glove must not get black on the inside, consequently none of the dye fluid should reach the inside of the glove. Brown is dyed by brushing on a decoction of fustic, red, and logwood, with a little alum. The quantities of dye-stuff to be used are regulated according to the tints. For darkening the color, a small quantity of solution of sulphate of iron is used. Morocco red is produced by brushing on a decoction of cochineal, to which a little salt of tin and oxalic acid is added. The tint is easily made darker by adding a little logwood. Gray is produced by brushing on a decoction of sumach, and subsequent treatment with a weak solution of sulphate of iron; greenish gray by the addition of fustic and logwood, also fustic and indigo carmine, to the decoction of sumach. The aniline colors all fix themselves without any further addition by

brushing their solutions on the glove. In place of the brush a sponge may be used where it seems suitable. In order to give black a pleasing bluish appearance, after the dyeing it may be washed with a little sal ammoniac. Should the seams in the gloves remain white after dyeing, they are coated with a paste in which a little fat is put.

TRACING-PAPER THAT MAY BE WASHED.

A GERMAN invention, and which may be useful to draftsmen and others, has for its object the rendering more or less transparent of paper used for writing or drawing either with ink, pencil, or crayon, and also to give the paper such a surface that such writing or drawing may be completely removed by washing without in any way injuring the paper. The object of making the paper translucent is, that when used in schools, the scholars can trace the copy, and thus become proficient in the formation of letters and outlines without the instruction usually necessary; and it may also be used in any place where tracings may be required, as, by laying the paper over the object to be copied, it can be plainly seen. Writing-paper is employed by preference, its preparation consisting in first saturating it with benzine, and then immediately coating the paper with a suitable rapidly-drying varnish before the benzine can evaporate. The application of varnish is by preference made by plunging the paper in a bath of it, but it may be applied with either a brush or a sponge. The varnish is prepared of the following ingredients: Boiled bleached linseed-oil, 20 pounds; lead-shavings, 1 pound; oxide of zinc, 5 pounds; Venetian turpentine, half a pound; mix and boil eight hours. After cooling, strain, and add white gum copal, 5 pounds, and gum sandarac, half a pound. Thus prepared, the paper will be found to possess all the requisites for use as stated above.

HEATING, EXTINGUISHING FIRES, ETC.

J. A. COLEMAN, of Providence, R. I., proposes to locate a group of boilers in a central location in a city or neighborhood, and to run pipes from the boilers to the different buildings through which steam may be supplied either for heating or to supply power to manufactories, etc., and at the same time form a means whereby steam may be forced into the buildings through a series of perforated pipes to extinguish fires. He also suggests the connection of said pipes with the water-mains, so that by turning a cock, water may be let into the steam-pipes and used for the latter purpose.

IMPROVEMENT IN THE MANUFACTURE OF SUGAR.

EUGENE LANGEN, of Cologne, Prussia, states that the time usually required for the production of loaf-sugar may be reduced from fourteen days to two or three, thereby saving a large quantity of the white sugar ordinarily employed in the claying process, and avoiding the loss of sugar from the formation of acids during the long period hitherto considered necessary. This is accomplished by evaporating the sugar as usual, and placing it in the moulds, which, however, are of peculiar form, being segmental in shape and provided with a movable bottom, which forms the longest side of the segment. The sugar is left in these moulds until set, when the bottoms of the latter are removed, and the sugar (still in the moulds) is set in a centrifugal machine made to receive the latter with their open bottoms outward. The rapid rotation to which the sugar is now subjected expels the syrup from the loaves, and the latter with their moulds are removed, the bottoms again replaced and the moulds and sugar placed in an air-tight tank which is then half filled with the claying liquor—the latter having much less white sugar than usual. The air is now exhausted from the interstices of the loaves, and the claying liquor penetrating such interstices drains the syrup which coats the grains or crystals of sugar. The moulds with their contents are next taken from the tank, the bottoms again removed, and the claying liquor expelled by a centrifugal machine. If the sugar is not sufficiently clear, it may be again subjected to the claying and draining operations.

TRACING-PAPER.

A CONVENIENT method for rendering ordinary drawing-paper transparent for the purpose of making tracings, and of removing its transparency so as to restore its former appearance when the drawing is completed, has been invented by C. Puscher. It consists in dissolving a given quantity of castor-oil, in one, two, or three volumes of absolute alcohol, according to the thickness of the paper, and applying it by means of a sponge. The alcohol evaporates in a few minutes, and the tracing-paper is dry and ready for immediate use. The drawing or tracing can be made either with lead-pencil or india-ink, and the oil removed from the paper by immersing it in absolute alcohol, thus restoring its original opacity. The alcohol employed in removing the oil is, of course, preserved for diluting the oil used in preparing the next sheet.

NOVEL FIRE-ALARM.

N. M. BOOTH, Evansville, Ind., has lately put a novel fire-telegraph and steam-signal apparatus into operation in that city.

The telegraph is so arranged that, when the circuit is closed, it pulls the support from under a lever. The lever, being an extension of the handle to a cock, falls and swings back and forth, letting on the steam and cutting it off as it continues to swing. When oscillation ceases, the whistle gives a prolonged scream until the lever is replaced ready for another alarm. This line is only a part of Major Booth's invention, being intended as a signal to the engineers to put on extra water pressure in the water-pipes when a fire occurs. On a recent trial, a police officer turned the alarm-key, when instantly the steam-whistle tooted out five or six puffs and then settled down to a long shriek.

PRESERVING CANVAS, CORDAGE, ETC.

C. NELSON, of Gloucester, Mass., states that the ordinary compounds used for the above purpose, although affording a partial protection against mildew, yet owing to their corrosive action, apparently weaken the material in warm climates, and therefore proposes to use the following solution and process: Dissolve one pound of sulphate of zinc in forty gallons of water, and then add one pound of sal-soda. After these ingredients are dissolved, two ounces of tartaric acid is added, which holds the partially separated carbonate of zinc in solution without neutralizing the excess of alkali used. The canvas, etc., should be soaked in this solution for twenty-four hours, and then dried without wringing.

A NOVEL FAN.

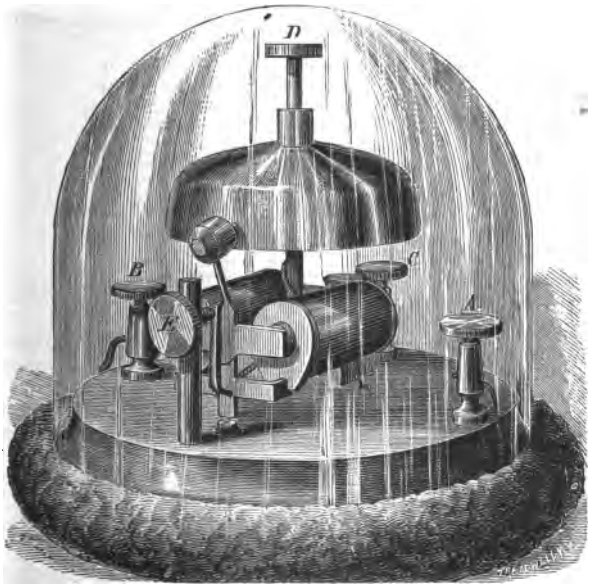
C. H. CLARK, of Hartford, Ct., is the author of a novel fan for feminine use, contrived as follows: The interior of the handle of the fan contains a train of small wheels operated by a spring. The wheels are connected with the fan, the latter being pivoted to the handle. The arrangement is such that on winding up the spring the fan oscillates, without any exertion on the part of the lady.

SEPARATING BURRS FROM WOOL.

THOMAS CROSSLEY, of Bridgeport, Ct., states that by using the usual acidulous solution to soften the claws of the burrs, the fibre of the wool is injured in its lustre and fulling quality, and he therefore suggests the employment for the purpose of the fumes made by the burning of sulphur and saltpetre, which are allowed to rise through the wool placed on a grating.

THE MINIATURE TELEGRAPH.

FOR about a year past, we have had in use here, in the office of the *Scientific American*, a very simple and convenient little electrical device, termed as above, the Miniature Telegraph, the invention of Mr. Lawrence Duerden, telegraph engineer of the Broadway Underground Railway, in this city. It consists of a pretty little electric bell, shown in its full size in the accompanying engraving,



THE MINIATURE TELEGRAPH. FIG. 1.

Fig. 1. As used in our office, these instruments are placed upon the desks in the various departments of our establishment, and from them wires extend to the desks of the managers, on which buttons are fixed, which connect with the wires. When the manager wishes to communicate with any particular person on the premises, he touches the button corresponding to the wire leading to the bell where the individual is at work. The touch sounds the bell, and, as a variety of signals may be sent, one bell may serve to signalize different persons who are within its hearing. It is surprising how many steps the use of this little contrivance saves, and how greatly it facilitates the

transaction of our office business. Previous to its introduction, it was necessary for us to employ messengers, who did little else than run from one part of the premises to another, consuming time and making mistakes. The miniature telegraph saves all such troubles, and enables the manager, without leaving his seat, to communicate instantly with all the principal persons employed in the concern. (See Fig. 2.) We have seven of these little instruments in use in our office, which serve us in signalizing a large number of persons. For factories, stores,

THE MINIATURE TELEGRAPH. FIG. 2.

shops, and offices, for dwellings, in lieu of the ordinary bells, for signaling from house to barn and for all the thousand and one purposes of business and domestic communication, this improvement is very useful. The makers fit up offices and buildings with them when desired. The device is so simple that any person of ordinary intelligence may put up the wire and set into use. It is so made that by shifting a wire from one screw into another it may be used as a telegraph, giving single signals, or as a burglar-alarm, making a continuous ringing. The cost is only $5. For this sum, the manufacturers supply one of the bells, like those we use in our office, pictured above, together

with connecting wires, chemicals, and a small battery, all complete for working the instrument, with directions for use: neatly put up and sent on receipt of price to all parts of the world by the manufacturers, F. C. Beach & Co., No. 260 Broadway, corner Warren street, New-York. At a slight additional cost, the makers supply a larger battery, such as we use in our office, which runs six or eight months without renewal.

IMPROVEMENT IN THE MANUFACTURE OF SOAPS.

THAT class of hard soap which is filled with a considerable quantity of soda or its equivalent becomes covered during the process of drying with an alkaline formation, which results in the crumbling and deterioration of the material; and to overcome this difficulty, W. V. Wallace, of Boston, dips the bars in a mixture of resin-soap, beef-tallow, and wax or spermaceti, so as to give them a surface coating, after which, the soap is placed upon racks to dry.

A PHOTO-PRINTING IMPROVEMENT.

AN improvement in photographic printing, by W. H. Jacoby, Minneapolis, Minn., is as follows: If the printing is to occupy one minute, the sensitive paper is exposed in contact with the negative for forty-five seconds, and the paper is then separated from the negative to a distance of, say, one eighth of an inch, and the exposure continued for fifteen seconds. This produces a sort of double printing, and imparts a soft mezzotint effect to the picture which is very pleasing. The separation of the paper from the negative is done by means of a peculiar construction of the printing frame.

GRANULATED GUN-COTTON.

S. J. MACKIE, of London, proposes to manufacture granulated gun-cotton by the following series of operations: The treatment of vegetable fibre with acid so as to transform it into ordinary gun-cotton, the crushing of the fibre by means of rollers, etc., so as to destroy its capillary structure and reduce it to an impalpable mass; the granulation of the mass, by mixing it with about forty per cent of sugar and ten per cent of nitre, and then sifting; and afterward drying *in vacuo*.

FIRE-EXTINGUISHERS.

IT has been suggested by I. P. Tice, of New-York, that an automatic fire-extinguisher may be made by setting up on trunnions or otherwise one of that class of apparatus

WATERPROOF PAINT FOR CANVAS.

THE following is a cheap and simple process for coating canvas for wagon-tops, tents, awnings, etc. It renders it impermeable to moisture, without making it stiff and liable to break. Soft-soap is to be dissolved in hot water, and a solution of sulphate of iron added. The sulphuric acid combines with the potash of the soap, and the oxide of iron is precipitated with the fatty acid as insoluble iron soap. This is washed and dried, and mixed with linseed-oil. The addition of dissolved india-rubber to the oil improves the paint.

BLACK VARNISH FOR ZINC.

PROFESSOR BÖTTGER prepares a black coating for zinc by dissolving 2 parts nitrate of copper and 3 parts crystallized chloride of copper in 64 parts of water, and adding 8 parts of nitric acid of specific gravity. This, however, is quite expensive; and in some places, the copper salts are difficult to obtain. On this account, Puscher prepares black paint or varnish with the following simple ingredients: Equal parts of chlorate of potash and blue vitriol are dissolved in 36 times as much warm water, and the solution left to cool. If the sulphate of copper used contains iron, it is precipitated as a hydrated oxide and can be removed by decantation or filtration. The zinc castings are then immersed for a few seconds in the solution until quite black, rinsed off with water, and dried. Even before it is dry, the black coating adheres to the object so that it may be wiped dry with a cloth. A more economical method, since a much smaller quantity of the salt solution is required, is to apply it repeatedly with a sponge. If copper-colored spots appear during the operation, the solution is applied to them a second time, and after a while they turn black. As soon as the object becomes equally black all over, it is washed with water and dried. On rubbing, the coating acquires a glittering appearance like indigo, which disappears on applying a few drops of linseed-oil varnish or "wax milk," and the zinc then has a deep black color and gloss. The wax milk just mentioned is prepared by boiling 1 part of yellow soap and 3 parts Japanese wax in 21 parts of water, until the soap dissolves. When cold, it has the consistency of salve, and will keep in closed vessels as long as desired. It can be used for polishing carved wood-work and for waxing ballroom floors, as it is cheaper than the solution of wax in turpentine, and does not stick or smell so disagreeable as the latter. A permanent black ink for zinc labels is prepared by dissolving equal parts of chlorate of potash

and sulphate of copper in 18 parts of water, and adding some gum-arabic solution. The black polish above described is recommended as permanent and capable of resisting quite a high temperature.

DYEING OF FELT WITH ANILINE COLORS.

FOR the dyeing of felt hats, aniline colors can be used in every case. The coloring matter is used repeatedly to make the tint satisfactory. If the dyeing follows the fulling, the felt is not penetrated so easily, but the hair can be directly dyed and the dyed hair fulled. For this purpose, a solution of the dye is made in boiling water, then allowed to cool, and filtered. A pan with water heated to 30° is prepared, and into this the necessary quantity of dye is introduced, stirred up, and the hair moistened, and inclosed in a basket is placed in the bath. The bath is repeatedly heated to 60°, and the basket agitated therein continually. Fresh coloring matter is introduced when the hair has absorbed a certain amount, the basket being for the instant removed.

When the hair is fully dyed, the basket is removed and the hair allowed to cool, and it is then well rinsed. Mixtures of aniline colors may be used for particular tints with good effect.

For *brown*, the by-products from fuchsine are employed, which are known in the trade as "cerise," "merron," etc. These give with indigo-carmine and picric acid, with addition of a little sulphuric acid, splendid brown shades. For the preparation of the favorite "Bismarck," a solution of Manchester brown can be used, which is toned down by addition of indigo-carmine, picric acid, and fuchsine.

(32, 36)

TEST FOR ARSENICAL COLORS ON WALL PAPERS AND IN PAPER GENERALLY.

PROFESSOR HAGER recommends the following method for detecting this dangerous class of arsenical colors, which, we may remark, are not confined to green alone, for even red sometimes contains arsenic: A piece of the paper is soaked in a concentrated solution of sodium nitrate (Chili saltpetre) in equal parts of alcohol and water, and allowed to dry. The dried paper is burned in a shallow porcelain dish. Usually it only smoulders, producing no flame. Water is poured over the ashes, and caustic potash added to a strongly alkaline reaction, then boiled and filtered. The filtrate is acidified with dilute sulphuric acid, and permanganate of potash is added slowly as long as the red color disappears or changes to a yellow brown upon warming, and finally a slight excess of chameleon solution

is present. If the liquid becomes turbid, it is to be filtered. After cooling, more dilute sulphuric acid is added and also a piece of pure clean zinc, and the flask closed with a cork split in two places. In one split of the cork a piece of paper moistened in silver nitrate is fastened, in the other a strip of parchment paper dipped in sugar of lead. If arsenic is present, the silver soon blackens. The lead paper is merely a check on the presence of sulph-hydric acid. According to Hager, the use of permanganate of potash is essential, otherwise the silver paper may be blackened when no arsenic is present.

WHITE PAINT FOR METALLIC SURFACES.

WHEN oil-paints are used for metallic surfaces that are subjected to heat, they turn yellow and brown from the burning of the organic portion of the paint. If, instead of oil, soluble glass be used, there will be no organic or combustible substance to brown it. Zinc-white mixed with soluble glass of from 40° to 50° B., to the consistency of ordinary paint, forms a beautiful and permanent color that will stand any required heat, without browning and blistering, and can only be removed by mechanical means. A not very large quantity should be mixed at one time, as a chemical change takes place and the paint hardens.

MIXTURES FOR SIGNAL FIREWORKS.

THE following proportions are given in an English patent by E. A. Lamarre, of Paris, for colored lights for signals:

White light.....	100	parts potassium chlorate,
	10	" antimony sulphide,
	15	" boiled linseed-oil.
Red light.....	50	" potassium chlorate,
	50	" strontium nitrate,
	5	" wood charcoal,

with as much linseed-oil as is required to knead the mass together.

Green light.....	50	parts potassium chlorate,
	50	" barium nitrate,
	5	" wood charcoal,

and linseed-oil as above. The use of linseed-oil is claimed as a specialty in substitution of oil of turpentine or resin.

PARISIAN WOOD-VARNISH.

To prepare this varnish, which has been long celebrated, the author dissolves 1 part of good shellac in 3 or 4 parts of alcohol, of 92 per cent, (by volume,) on the water-bath, and cautiously adds distilled water, until a curdy mass separates out, which is collected and placed between linen; the liquid is filtered through paper, all the alcohol

removed by distillation from the water-bath, and the resin removed and dried at 100° until it ceases to lose weight; it is then dissolved in double its weight of alcohol, of at least 96 or 98 per cent, and the solution perfumed with lavender oil.—*R. Grager.*

NEW PROCESS FOR PURIFYING COAL-GAS.

By Vernon Harcourt.—The author states that the usual method of freeing coal-gas from sulphureted hydrogen was by passing it through lime. But oxide of iron was also employed, in place of the lime; the advantage possessed by the oxide being that, while the lime, after it had served its purpose, was useless and difficult to get rid of, the oxide of iron could be used repeatedly for the same purpose. The chemical changes involved were that, when the gas had passed through the oxide, the latter was changed into sulphide of iron; when the sulphide was exposed to the air, the sulphur separated and the oxide was re-formed, thus enabling the oxide to be again used. This was called a continuous process, because the oxide could be continuously used. But the process was not quite continuous, for, after the oxide had been used some thirty times, it became so clogged with sulphur as to be useless. The new process was applicable wherever oxide of iron could be used in the purifying process. The difference from the old process was, that the oxide, during revivification, was moistened with a solution of ferric sulphate, (persulphate of iron,) and a portion of the oxide was removed, from time to time, and treated as follows: It was first extracted with water by the use of a well-known arrangement. The soluble salts were sulphate of ammonia, (formed in the purification by the reaction of ammonia upon ferric sulphate,) and, in smaller quantities, sulphocyanide, hyposulphite, and probably sulphate of ammonia. This extract was mixed with a small excess of sulphuric acid; and yielded, when concentrated by evaporation, crystals of ammonium sulphate. The remainder of the substance was then boiled with dilute sulphuric acid, which dissolved the oxide and left a residue of sulphur. The actual process of extraction by acid consisted in treating the substance successively with (1) a solution of ferric sulphate containing some free sulphuric acid; (2) with a more dilute solution of ferric sulphate to which sulphuric acid had been added; (3 and 4) with more dilute solutions of ferric-sulphate, (all these liquids being the product of a former extraction;) and (5) with water. The liquid resulting from the first of the treatments enumerated above was a strong solution of ferric-sulphate;

which was used, as already mentioned, by being mixed with the charge of oxide before it was replaced in the purifier. The residue of the final washing consisted almost entirely of sulphur, and required only to be dried. It would be evident that all the oxide which had been freed from sulphate of ammonia and sulphur by this treatment passed into the condition of ferric sulphate, and in this condition it was replaced in the purifier. There it again became oxide, by the action upon it of the ammonia in the gas, which it completely removed, fixing it as sulphate. This system had been brought into use as a manufacturing process; and had been found to be, as far as could be judged, a complete success.

THE OXYHYDROGEN LIGHT.

DR. JOHN NICOL describes a new mode of making lime cylinders as follows:

Four parts of precipitated chalk are intimately mixed with one part of ponderous carbonate of magnesia, and the whole made into a stiff paste with mucilage of gum-arabic. The mass should be well beaten into a mortar, or in any other way to insure thorough incorporation, and made a little stiffer than glazier's putty. It may then be rolled on a slightly oiled marble or porcelain slab, or smooth board, till it assumes the form of an ordinary ruler, and then cut into suitable lengths. The holes are easily made with a wire of the proper thickness; and if the wire be "olive ended," like those used for piercing tobacco pipe-stems—that is, having a tiny bulb or button at the end to be inserted—it will penetrate straighter and easier. The cylinders thus finished only further require drying, which may readily be done in the kitchen-oven; and as they must be thoroughly dry, they may be left there for two or three days.

SILICA LENSES.

IN a new work entitled *Telescope and Microscope*, recently published in France, the following method of obtaining a lens for a cheap microscope is ascribed to an experiment of Sir Humphry Davy. The process consists in igniting one end of a wheat or hay straw and allowing the entire spear to consume gradually. The cinder is then heated in the blue flame of a burner; and from the silex contained, a solid globule of glass is formed, said to be well suited for microscopic purposes.

THE SPECTROGRAPH.

THE name is given to a simple little device for copying drawings, exhibited in the French department of the

Vienna Exposition. It consists of a board, near the middle of which is a piece of window-glass fastened at right angles to it by means of two grooved wooden uprights. When placed near a window, with a drawing or copy on the end of the board nearer the window, its reflection in the glass causes it to appear upon a sheet of white on the opposite side of the glass. In this way quite an accurate tracing can be made by one who is no draftsman.

PHOTO-CHEMICAL ENGRAVING.

IT has been found by M. Merget and M. Gourdon—and, indeed, has been long known to physicists and chemists—that zinc covered, or in contact, with platinum or certain other metals, is readily acted upon by acids which have little or no effect upon pure zinc. If a plate of chemically pure zinc be plunged into sulphuric acid diluted with ten times its volume of water, it is but very feebly acted upon ; but if partly coated with metallic platinum, by drawing a line with solution of tetrachloride of the metal across the plate, and then, after the complete reduction of the platinum salt by the zinc, the plate be plunged into the acid, the latter will be found to act energetically along the platinum line. This action is essentially electro-chemical.

If a plate of ordinary zinc, carrying an image in platinum, be plunged into an acid containing one part of sulphuric acid in two thousand parts of water, the metal will only be attacked where it happens to be in contact with the platinum, and an etching of any desired depth can thus be obtained.

But the production of a good image on the zinc is the real difficulty, and under this head we have yet little information. The plan pursued by M. Gourdon is to place a fixed and washed positive silver print on paper face downward on the zinc, and then to moisten, first with ammonia and then with cyanide of potassium. A certain amount of the silver forming the image is thus transferred to the plate, which can then be etched by acid containing the one two thousandth of its volume of sulphuric acid.

These and other experiments hitherto made do not appear to have been very successful, as half-tones were not rendered ; still the plan is not only interesting, but appears to contain the germ of a good and simple process of photo-chemical or electro-chemical etching, and is well worth the attention of those interested in this branch of our art. Before we close these remarks, we may offer a suggestion which may aid in the solution of the difficulty.

Any process depending on the solution of the silver of a print, and its subsequent deposition on the zinc by reduction from a liquid, could not be expected to produce satisfactory results; we would therefore suggest that the silver print should be toned with gold or with platinum, and, when washed and dry, exposed to the action of chlorine gas. Soluble chloride of gold or platinum and insoluble chloride of silver will be formed. The print should then be pressed into close contact with the zinc.

Now, since the chloride of gold or platinum carried by the print is deliquescent, we should expect that a sufficient amount of moisture would be absorbed from the atmosphere to enable the zinc to decompose the gold or platinum salt, and reduce upon its surface the noble metal, and so spreading or blurring of the image be avoided by limiting the action to the right place. By some such plan, we should think it quite possible to obtain a tolerably sharp impression in gold or platinum on a zinc plate, and from a sensibly dry paper print, provided the action of the chloride in the first instance is properly regulated, and the pressure to which the print and plate are together subjected is sufficiently great. (1)

A NEW PHOTO-PROCESS.

A RECENT improvement, announced by Mr. Burgess, a photographic artist of Peckham, England, consists in sensitizing gelatine by means of bromide of silver. The mixture is applied warm to the glass plate, and the picture may be taken with the plate either wet or dry. The time of exposure is the same as for the ordinary wet collodion plates. The alkaline-pyro developer is used, the picture making its appearance rapidly, with any required degree of intensity. The new process promises to compete sharply with the ordinary collodion process.

TO CLEAR PHOTO BATHS.

WHEN photo printing baths become discolored, various agents are employed in order to decolorize them. Among the best of these is the substance known as China clay or kaoline, which consists almost entirely of silicate of alumina. At the present period, paper is adulterated to a large extent by the admixture of clay, and hence, when a silver-bath has become discolored, owing to the presence of organic matter, an effectual remedy is always at hand; for, in the absence of kaoline, all that is necessary is to burn any good, heavy-bodied paper and shake up the ashes with the silver. On filtration, it will be found to have become pure and bright,

ANILINE BLACK.

BY C. LAUTH.—The process of dyeing with aniline black employed by the author consists in first mordanting with peroxide of manganese, and subsequently dipping in a cold and strongly acid solution of aniline. The tint is afterward improved and intensified by various agents. Bichromate of potassium, the salts of copper, of chromium, and of mercury, and especially a mixture of chlorate of potassium, copper salt, and sal-ammoniac effect this purpose. This process gives fine permanent blacks, but the mordanting is somewhat troublesome, and the black rubs off a little. (32)

A NEW TEXTILE PLANT.

THE jury at the recent Exposition at Lyons, France, awarded a medal for the utilization of the fibre of a marsh plant, commonly known as the *massette*. It is of the typha family, and three varieties, namely, *typha latifolia*, *augustifolia* and *minima*, yield the fibre. The plant grows in a wild state in great profusion in streams of water, ponds, etc., and reaches a height of some ten feet. Heretofore it has been employed for seating of chair-bottoms and thatching of cottages, and occasionally in place of straw as bedding for animals.

The mode of extracting the fibre from the leaves after the latter are cut and dried consists simply in boiling them for several hours in an alkaline solution, and afterward dressing them in a mill or under rollers. Washing terminates the process. A yellowish paper is made, worth about $16 per 220 pounds. The fibre, it is believed, may be used for fabrics and for cordage, and is considered equal to hemp, flax, or jute.

BLUE DYE DERIVED FROM CARBOLIC ACID.

THE carbolic acid is mixed with 8 or 10 parts stannate of soda, to which is immediately added concentrated sulphuric or hydrochloric acid. By using the former, a yellow substance is obtained, soluble in tartrate of soda and in the alkalies. By the addition of a large proportion of acid, the mixture becomes reddish brown, and all the carbolic acid dissolves. Combined with a large amount of water, the solution becomes red, and brown flakes, soluble in alcohol, are deposited.

These flakes give to alkalies a blue coloring matter, which is not precipitated either by water or alcohol. It has not been isolated, except on the fabric. The red watery solution treated with alkalies becomes green on account of the formation of the blue dye and a yellow substance. If a fabric of oiled cotton be plunged therein,

it is rapidly colored orange, which tint, like the liquid, passes to green when acted upon with alkalies; but if the dyed material be finally left to the action of water, it becomes a sky-blue, which is almost unalterable by chlorine and the hypochlorites.

COLORING SILK BLUE.

TWENTY parts sodium molybdate and 20 parts sodium thio-sulphate are dissolved in 250 parts water. To this solution, heated to boiling, 6 or 8 parts ordinary hydrochloric acid are gradually added. A beautiful blue liquid is thus obtained.

ROSIN-OIL.

"VULCAN OIL" is the distillate of Virginian petroleum which passes over almost at the last, and has a sp. gr. from 0.870 to 0.890. This, while warm, is acidified with 6 per cent of fuming sulphuric acid in a lead vat, then drawn off from the acid, and washed with water to the complete removal of the acid. The product is then mixed with 5 per cent of rape-oil. Also that oil which distills over in the petroleum distillation after the illuminating oil (until of sp. gr. 0.860) passes over, is taken separately, until it solidifies when dropped upon a cold metal plate, and with this 5 per cent of crude rape-oil is mixed.

Another lubricating oil from petroleum is the "opal oil." This oil, of sp. gr. 0.850 to 0.870, is acidified like "vulcan oil," and mixed with 10 per cent of rape-oil.

For parts of machinery which move with great rapidity, as railway axles, spindles, etc., lubricating oils from petroleum can not be used. "Rosin-oil," when specially purified, is far the best for this purpose. Its strong odor, as also the liability to separate rosin when warm, are removed as follows: 100 pounds of dry thick rosin-oil are heated in a pan till of thin fluidity. The fire is then removed, and three pounds of fuming sulphuric acid are gradually dropped in, with constant stirring. After a half an hour's mixing, the oil is left to stand for twelve hours, and is then drawn off by a syphon into a wooden vat. It is then washed with hot water, drawn off after twelve hours' settling, and the washing is repeated till the water runs off without acid reaction. The water is at first added hot to the oil without mixing, as long as it flows off milky. After several days' separation, a dark yellow, faintly odorous rosin-oil is obtained without blue reflection. This oil, mixed with olive or rape-oils, may be used advantageously for lubricating the heavy parts of machinery.

To obtain the oil perfectly free from odor, and of clear yellow tint, the dark yellow rosin-oil is run into a flask or

globe, and to 100 pounds of rosin-oil 1 pound of water is added. The whole is well shaken, and gradually 8 pounds of hydrochloric acid diluted with 10 pounds of water are mixed in. To this, 1 pound of red-lead and 5 pounds of dilute hydrochloric acid are added, and the whole is frequently shaken. After some days, the oil is drawn off, washed with water till free from acid, and set in the sunlight for about eight days in a flask. Thus treated, it becomes of a light yellow tint.

The yellow rosin-oil, when mixed with one third rape or olive-oils, yields a good lubricating oil for all machine purposes. It does not deposit rosin in the slightest. It can also be mixed with petroleum. Mixed with rape-oil, it appears in trade as an adulterant for olive-oil. (32, 36)

PURIFICATION OF LUBRICATING OIL THAT HAS BEEN USED.

We find the following details of a practical method for regenerating lubricating oils given in an Austrian paper: A wooden tub holding 63 quarts has a faucet inserted close to the bottom, and another about 4 inches farther up the side. In this apparatus is placed 7 quarts of boiling water, in which are then dissolved 4½ oz. chromate of potash, 3½ oz. carbonate of soda, 3½ oz. chloride of calcium, and 9 oz. common salt. When all these are in solution, 45 quarts of the oil to be purified is let in and well stirred for 5 or 10 minutes; after which it is left to rest for a week in a warm place, at the expiration of which time the clear pure oil can be drawn off through the upper stop-cock without disturbing the impurities and cleansing fluid at the bottom.

ROSIN-OIL AND ITS USES.

Rosin-oil is a product of the dry distillation of rosin. The apparatus used consists of an iron pot, a head piece, a condensing arrangement, and a receiver. In the distillation, a light oil comes over first, together with water. As soon as a cessation in the flow of the distillate occurs, the receiver is changed, and the heat is further raised, when a red-colored and heavy rosin-oil comes over. The black residue remaining in the pot is used as a pitch. The light oil, called "pinoline," is rectified, and the acetic-acid water passing over with it is saturated with calcium hydrate, filtered and evaporated to dryness, and the calcium acetate obtained is employed in the manufacture of acetic acid. The rosin-oil, obtained after the light oil has passed over, has a dark violet-blue color, and is called "blue rosin-oil." The red oil is boiled for a day with water, the evaporated water being returned to the vessel; next day the water is

drawn off, and the remaining rosin-oil is saponified with caustic soda lye of 36° Beaumé, and the resulting almost solid mass is distilled so long as oil passes over. The product obtained is rectified rosin-oil, which is allowed to stand in iron vessels, protected by a thin layer of gypsum, whereby, after a few weeks, a perfectly clear oil is obtained free from water. The oil of first quality is obtained by a repetition of the foregoing operation upon the once rectified oil. The residues of both operations are melted up with the pitch.

ROSIN-OIL SOAP.

ONE hundred pounds of rosin-oil and 80 pounds of lime slaked to a powder are agitated in an iron pot, and the mixture is heated with stirring, till a uniform paste is obtained, free from lumps and running from the stirring implement like syrup. With this rosin-oil soap, all the different varieties of patent wagon-grease are made as follows:

BLUE PATENT GREASE.—500 lbs. red rosin-oil are heated for one hour with 2 lbs. calcium hydrate, and allowed to cool. The oil is skimmed off the sediment, and 10 to 12 lbs. of rosin-oil soap are stirred in till all is of buttery consistence and of blue color.

YELLOW PATENT GREASE is prepared by adding 6 per cent of turmeric solution to the blue grease.

BLACK PATENT GREASE.—Lamp-black is used to produce the black color.

PATENT PALM-OIL WAGON-GREASE.—10 lbs. of rosin-oil soap are melted with 10 lbs. of palm-oil; 500 lbs. of rosin-oil are then added, and as much rosin-oil soap to make the whole of the consistence of butter, and lastly 7 to 8 lbs. of caustic soda lye.

PARAFFINE RESIDUES.—The thick oil which remains in the paraffine manufacture is used as a lubricating oil, partly on account of its cheapness, and partly on account of its not soon solidifying by cold.

In order to thicken, some lead-soap is melted with it. Mixtures of rosin-oil or rosin-oil soap and petroleum, with glycerine also, are often used as lubricants. (32)

THE MANUFACTURE OF CARBON.

ABOUT a year ago, Mr. Haworth, a gentleman from Boston, having heard of the burning well at Cumberland, Md., tested the quality of the gas, and was satisfied that he could put into operation a scheme or plan of his own for the manufacture of carbon from the gas. Accordingly, the well was leased or purchased by Mr. Haworth and others, known as Lamb & Co., and a patent obtained for

he manufacture of carbon, according to the plan of Mr. Haworth. A building was constructed and the manufacture of carbon commenced about six months ago. There are now in operation six hundred and sixty burners, each burner consuming eight cubic feet per hour. The gas is allowed to burn against soapstone plates, on which the carbon is deposited in the form of soot. By a very neat mechanical arrangement, the soot is scraped off and deposited in large tin boxes about three feet long, and a foot and a half wide, and a foot and a half deep; scrapers are passed along the soapstone plates every twenty minutes, and the boxes are filled on their fourth passage. A large building is now in course of construction, twice the size of the present one, and will have in use thirteen hundred and twenty eight-feet gas burners. The present consumption of gas amounts to about one twelfth of the whole quantity escaping from the well. When the new building is completed and the burners put in operation, the total consumption of gas, by the burners of both buildings, will be one fourth of the whole.

The carbon is used for the manufacture of ink, and these works, we believe, are the only ones of the kind in the world.

ON THE MANUFACTURE OF ETHER.

O. SUFFENGUTH states that the best method of making large quantities of ether is by the continuous process. A retort, containing a mixture of nine parts sulphuric acid, of 66° B. and five parts 90 per cent alcohol, is heated to 284° Fahr., and alcohol allowed to flow in continuously, to keep the mixture at a constant level. Heretofore a direct fire has been applied under the copper or iron retort; but, owing to the inflammability and volatility of the ether, this is evidently dangerous; and, moreover, the direct fire soon destroys the retort, or at least dissolves the leaden lining. This is now entirely avoided by the use of superheated high-pressure steam for heating the retort. Even though this method is rather more expensive, it prevents igniting and exploding the ether-vapor, which quite compensates for the cost. Another advantage is the ease with which a constant temperature is maintained, by regulating the pressure, so that the operation is no longer dependent upon the care and experience of the workmen.

Various materials have been used for the retort or still; sometimes copper alone, sometimes copper lined with lead, and also iron lined with lead. Experience has proved that the last-named is not only the cheapest, but will last the longest. If the operation is carefully con-

ducted, 66 per cent of ether, of a specific gravity of 0·730, will be obtained. Half a pound of sulphuric acid makes 100 pounds of ether, and the apparatus is so constructed that it can be refilled without interrupting the operation. Great attention to the regulation of the temperature and to the flowing in of the alcohol are the principal conditions for obtaining a large yield.

The crude ether thus obtained is freed from the acid dissolved in it, and washed, after which it is rectified in a suitable apparatus. Attempts have been made to rectify it in the process of its manufacture, by conducting the ether-vapor into a vessel with double walls, the space between the walls being filled with water at a temperature of 35° C., (95° Fahr.) Here the water and alcohol are condensed; while the ether passes up into a second vessel filled with pieces of quicklime, of the size of a man's fist, which take up the sulphurous acid. It is now warmed, and enters from beneath into a cylinder holding a leaden basket of dried wood-charcoal, or alternate layers of charcoal and pieces of coke soaked in a solution of soda and well dried. From here it is conducted, through a cooler, into the receiver. This continuous rectification is more difficult, and requires greater attention on the part of the workmen than where the purification is a separate operation: first, on account of the continual regulation of the temperature in the different parts of the apparatus; and secondly, because the lime sometimes stops up the tube, or is carried off in the vapor. The operation never goes on regularly, nor is the product always pure. It seems to be better, in practice, to keep separate the two operations of making and of purifying the ether.

THE MANUFACTURE OF MAGNESIA.

THE Washington factory, near Newcastle, England, manufactures the greater part of the magnesia used in the world. The principle of the process employed consists in treating dolomite with gaseous carbonic acid, under a pressure of five or six atmospheres. The dolomite is first dried, then finely pulverized, and afterward placed, with cold water, in a cylinder which constantly revolves on its horizontal axis. The carbonic acid gas, formed by the action of hydrochloric acid upon carbonate of lime, is, by a powerful pump, driven into the vessel at the pressure above noted. The solution of bicarbonate of magnesia thus produced is carried into a vertical cylinder, and submitted to steam, (the consequent elevation of temperature regenerating the neutral carbonate,) and then led into canals beside the last-mentioned receptacle. Lastly,

the substance is gathered into masses, from which are cu the parallelopipeds which, after desiccation, are supplied to commerce. Caustic magnesia is obtained by heating the carbonate in red-hot muffle furnaces.

NEW METHOD OF PREPARING CAUSTIC SODA.

THE crude lye is evaporated in cast-iron boilers. At a certain heat, the cyanides contained in the pasty mass are decomposed, with escape of ammonia and decomposition of carbon. When this point is reached, the heat is raised to redness, and the mass becomes more fluid. A sheet-iron cover is then fitted upon the boiler, provided with an opening through which enters an iron pipe. This is plunged into the mass, and air is forced in. The graphite which separates rises to the surface and may be collected. The mass is tested from time to time to see if the sulphur is perfectly oxydized. When this is the case, the blast is stopped, the mass allowed to become clear, and run off as usual.—*M. Helbig.*

SILICIC ACID AS A MORDANT.

IT is known that amorphous silica possesses considerable power for absorbing certain colors, especially certain aniline tints. Cotton impregnated with a silicate solution takes color rapidly and permanently. The best means of attaining this result is to treat the cotton with a solution of water glass and then to precipitate the silica in the fibre by means of an acid before placing the cotton in the dye. As regards freshness and beauty of shades, cotton thus prepared is much superior to that acted upon by tannic acid as a mordant. M. Reimann, the inventor of the process, is making experiments in order to fix aniline colors on glass, by previously attacking it with hydrofluoric acid.

MINERAL OILS FOR IRON.

THE use of heavy mineral oil as a preservative for iron is strongly recommended by the *London Oil-Trade Review*, the substance referred to being, we presume, one of the products of shale distillation, so extensively practiced in Great Britain. Whether a similar product can be obtained from our petroleums is a good subject for research. Our contemporary says:

The action of the oil is twofold. First, it is detergent when vigorously and freely brushed over an already rusted surface. It seems to loosen the bulk of the rust and it darkens that which remains. Secondly, it acts as a varnish if applied after the cleansing has been effected, or to new and bright work. Its superiority to vegetable or animal oils depends upon the fact that the bulk of the oil

evaporates, and it leaves only a very fine film behind. If the oil is light and fully refined, it evaporates so completely as to do but little good in this way; but if tinged or "once run" oil of sufficiently high gravity be used, the resinous or carbonaceous matter which gives the tinge to the oil remains behind and forms the thin protecting film of varnish. Ordinary varnish leaves far too thick and obvious a film, while the film of the once run oil does its work of protection without displaying itself. As regards the density of the oil required for this purpose, we recommend that which stands between the burning oil and good lubricating oil; it is known, and sometimes sold, as "intermediate oil." We are satisefid that a good trade may be done by any body who will bring this before the public in a proper manner, and supply the article as required. For domestic purposes, for the cleaning of all kinds of household iron-work, for the preservation of such things as mowing machines and other garden tools or exposed iron implements, the brown oil should be sold in small bottles at a cheap rate. For manufacturers of iron-work and for ironmongers, to whom it will prove invaluable, it must of course be supplied in larger parcels. At present, it can hardly be used at all, on account of the difficulty of obtaining it in retail quantities.

ENAMELED IRON.

M. PELIGOT has made a report to the Society for the Encouragement of Industry, on the enameled wrought and cast-iron work introduced by M. Paris about twenty-five years ago, and for which the society have awarded him two medals. According to the report in question, the enamel used is a true transparent glass, which allows the color of the iron to show through, very tenacious, having the same power of dilatation as iron, and capable of resisting powerful acids. The ordinary white enameled ware of Paris generally contains lead, and often in large proportions, and is liable to be attacked by even very weak acids. M. Paris's ware has been employed for many purposes: cast-iron vases for gardens, decorated in imitation of old Rouen ware, have been exposed to all weathers without suffering any injury; a chimney, in enameled plate-iron, was set up at the Mazas prison in 1849; the doors of the gold-assay furnace, in the laboratory of the Paris mint, are of the same, and have borne the effect of nitrous vapors since 1850; in 1866 this enameled iron was selected for street names and house-number plates, in several districts of Paris; and the report states that, while other manufacturers make enameled ware of the

same appearance as that of M. Paris, the latter has shown its superiority in resisting the effects of time.

Specimens of new applications, lately introduced by M. Paris, were presented to the society, and included chairs, tables, and stools for gardens, enameled on sheet-iron and mounted on castings; and stands for dishes, decanters, etc., made in imitation of ancient earthenware, but presenting the superior advantage of bearing heat well.

PROTECTING IRON.

CAST-IRON water-pipes and other articles may be preserved by covering inside and out with pitch, heated to 300° Fahrenheit and kept at this point during the dipping. As the material deteriorates after a number of pipes have been dipped, fresh pitch is frequently added, and at least eight per cent of heavy linseed-oil put to it daily; the vessel is also entirely emptied of the pitch and refilled with fresh material as often as is necessary, to insure the perfection of the process. Each casting is kept immersed from thirty to forty-five minutes, or until it attains a temperature of 300°. After the bath is completed, the castings are removed and placed to drip in such a position that the thickness of the varnish will be uniform. It is essential that the coating be tenacious when cold, and not brittle or disposed to scale off. The pitch or varnish is made from coal-tar, distilled until all the naphtha is removed, the material deodorized,and the pitch like thick molasses.

CARBON WATER-FILTERS.

WATER standing in a glass globe, the mouth of which was stopped with cotton-wool, showed after some days signs of vegetable growth on its surface. The same water, filtered through a carbon filter into a globe free from air, also soon showed like signs of the existence of life. The same water after boiling remained perfectly clear for days. I therefore conclude that carbon filters are useful only in purifying water from mechanical impurities, as sand, lime, etc., but that they can not remove any of the so-called germs.—*Julius Müller.*

SIMPLE FIRE-PLATING FOR IRON.

BY rubbing the surface of iron or other metals with soda amalgam, and then pouring over it a concentrated solution of chloride of gold, the gold is taken up by the amalgamated surface, and it is only necessary to drive off the mercury with the heat of a large lamp to obtain a fine gilded surface that will bear polishing. By writing or drawing a design on the iron, the drawing will be reproduced in pure gold. Silver and platinum salts are said to act in a similar manner to the gold.

ICE-MAKING MACHINERY.

THE making of ice by artificial means is a matter of rapidly increasing importance, not only on account of the increase it affords in our domestic comforts, but also on account of its usefulness in many manufacturing branches. The ice-making machine has already been of great service in breweries, as it renders the brewer independent of the supply of natural ice, while the ice-machine may also be used for the direct cooling of the air and the wort. Besides, ice made artificially by machinery is colder and therefore harder than natural ice; a fact which has clearly been proved by experiments lately made, when equal weights of both artificially and naturally produced ice were placed in warm water of equal temperature, the result being that the artificial ice took more than twice the time for melting that was required for the natural ice.

At Vienna were exhibited three ice-making machines: one by Messrs. Siebe & West, of Lambeth, London; one by Messrs. Vaas & Littman, of Halle-on-the-Saale; and a third by the *Actien-Gesellschaft für Fabrication von Eismaschinen*, formerly Oscar Kropff & Co., of Nordhausen, Prussia. The principle applied in Messrs. Siebe & West's machine consists of the production of a cold temperature by means of the evaporation of ether, and of the continued use of the same ether without any significant loss. The machine consists of a refrigerator, a condenser, an air-pump, and an ice-making box. The machine works in the following manner: As soon as the air-pump is put in motion, the ether in the cooling-vessel evaporates, and, of course, absorbs heat from the tubes by which the cooling vessel is traversed. The ether-vapor thus produced is forced by the air-pump into the condenser, where, under the combined influence of the pressure and the cooling action of the water circulating through the condenser, it resumes the liquid form and returns through a small tube to the refrigerator, in order to be there again changed into gas.

This process is continued with the use of the same ether as long as the machine is kept working. The great cold produced in the cooling-vessel acts on the fresh water to be frozen in the ice-box by means of a current of salt water introduced into the tubes which pass through. The temperature of the salt water decreases quickly, on its way through the refrigerator, on account of heat being absorbed from it by the ether changing into gas; and it then circulates, with a temperature considerably below the freezing-point, in the ice-box, round a number of iron or copper vessels filled with the fresh water to be frozen

into ice. The salt water, the temperature of which increases again by coming into contact with the vessels containing the fresh water, is taken back to the refrigerator, where its temperature is again reduced. The process of freezing is thus uniform, self-regulating, and uninterrupted, until the fresh water has been changed into ice. The latter is then removed, and the vessels are filled again with fresh water, and are again exposed to the cooling of the brine current. These machines of Messrs. Siebe & West's are now constructed like horizontal steam-engines; they are exceedingly simple and compact, and have a steam-engine attached, or may be worked from an existing shaft. The ice is made in single cakes, weighing between 8 pounds and 100 pounds, according to the size of the machine. If these cakes are placed one upon the other, they freeze together, so that blocks of any size may be formed. It is stated by Messrs. Siebe & West that they can produce from 10 pounds to 30 pounds of ice with their machines for two cents, and that one pound of coal produces between 3 pounds and 10 pounds of ice. The time taken in removing the ice and refilling the freezing vessels for the next operation occupies from 30 to 60 minutes. Messrs. Siebe & West state further that a temperature of 50 degrees below zero (Fahr.) has been obtained with this apparatus, and that from 50,000 to 500,000 cubic feet of air may be cooled per hour to 30 degrees Fahr., or a smaller body of air to a lower temperature. The ice made by this machine at the Vienna Exposition was beautifully clear and crystalline, as pure and hard as the best American or Norwegian ice.

Examining now the two German ice-making machines, we find that their construction is, in nearly every respect, identical; and, although based on the same thermodynamic principle, these machines differ, nevertheless, considerably from the English machine—in appearance as well as in working. The English machine appears to us a compact, thoroughly well-considered construction; while the German machines show a great number of tubes and vessels and cocks, which require a good deal of attention. The general *modus operandi* of the German machines is as follows: A boiler is partly filled with a concentrated solution of hydrochlorate of ammonia, which is heated, and ammoniacal gas is thus generated. This gas is forced through serpentine pipes in a condenser to a refrigerator, and from there it is admitted into the serpentine pipes of the ice-box. The ammoniacal gas is exposed, on its way to the ice-box, to a pressure of eight or ten atmospheres; while it is considerably cooled in the

condenser, the serpentine pipe of which is surrounded by cold water, the results being that the ammoniacal gas becomes condensed to a fluid form. The serpentine pipes of the ice-box are surrounded by a solution of hydrochlorate of lime; and the liquefied ammoniacal gas, passing through these pipes, resumes its gaseous form, and absorbs heat from the solution of hydrochlorate of lime. The boxes with the water to be changed into ice are placed in the ice-box, and immersed in the solution of hydrochlorate of lime. The fluid gas evaporated in the serpentine pipes of the ice-box passes into an accumulator, where it is absorbed by the fluid freed from ammonia, from which the gas has been produced by heat, this fluid having passed from the boiler through the refrigerator to the accumulator. The fluid is then again forced back, by means of a pump, into the boiler, whence it passes off again as ammoniacal gas.

These ammonia machines are built in six different sizes, for the production of from 10 pounds to 1000 pounds of ice per hour; requiring, for the same time, from 5 to 500 cubic feet of water, and from 5 pounds to 60 pounds of coals. The space occupied by the smallest machines is 6 by 4 feet, and that required for the largest is 45 by 20 feet. The ordinary shape of the ice produced by the machines is a square plate 2⅜ inches thick, 7¼ inches wide, and 29½ inches long, weighing about 20 pounds. (28).

NEW METHOD OF PREPARING ALUMINUM.

THE oxide of aluminum is first prepared by any of the processes now in use, either from kaoline or clay. It is then mixed with wood charcoal in the proportions of 40 parts charcoal to 100 of alumina, and heated to a red heat. While still hot, the mass is placed in retorts heated to dark redness, and chlorine gas is passed over it from a gasometer. The volatile chloride is condensed in the receiver, and afterward decomposed by the battery; the chlorine which is set free is returned to the gasometer to be used over repeatedly. The electric current, employed by Garneri, was produced by a magneto-electric apparatus.

A MUSICAL BLACKBOARD.

A RECENTLY patented improvement in devices for musical instruction consists of a blackboard on which are painted, in large characters, the usual notes of the musical scale. In the centre of each note is a movable key, which connects behind the board with an organ. When the teacher, with rod in hand, points out a note and touches its centre, the organ sounds the corresponding tone, and thus both eye and ear are instructed.

ARTIFICIAL TORTOISE-SHELL.

ACCORDING to the *Art Journal*, the appearance of tortoise-shell may be given to horn by brushing it over with a paste made of two parts of lime, one part of litharge, and a little soda lye, which is allowed to dry. This is the same as the Indian hair-dye, and acts by forming sulphuret of lead with the sulphur contained in the albumen of the horn, producing dark spots, which contrast with the brighter color of the horn. Artificial tortoise-shell is made by melting gelatine with various metallic salts. The greatest comb manufactory in the world is in Aberdeen. There are thirty-six furnaces on the works for preparing horns and tortoise-shell for the combs, and no less than 120 iron screw-presses worked by steam. Forty years ago, ladies' back combs—which were larger than ladies' bonnets are now—were made in England and the United States for the Spanish Peninsula and South-American markets. They were often a couple of feet wide, encircling two thirds of the head, and from six inches to one foot high on the back, the top being wrought in open work; to these the Spanish ladies attached their vails. As much of the work was done by hand and with the saw, and the polishing was entirely manual, the prices were high, averaging $15 to $20. Tortoise-shell was much used to decorate furniture by the Romans. According to Pliny, Carvillus Pollio was the first to apply tortoise-shell to ornamental purposes. The fashion for this style of decoration increased; and in the days of Augustus, the patricians ornamented their doors and the columns of their rooms with this substance. At one time, tortoise-shell was used for making watch-cases, but the art seems to have fallen into desuetude, although the results of attempts to resuscitate it were shown at the London Exhibition last year.

CINDER FUEL.

M. CHARY has recently made experiments with the view of utilizing cinders which have dropped through the grate. He suggests passing condensed air over red-hot cinders, whereby carbonic oxide is formed, which gives a flame of several feet in length, well adapted for boiler-heating. The greatest difficulty lay in the ultimate removal of the refuse cinder. From his short experience in this direction, he calculates that 2 lbs. of cinders, sorted by hand, give a heating effect equal to that obtained by 1 lb. of coal. It has been argued that the mode of separation was of the greatest practical importance. The wet process was not to be recommended, on account of the extensive drying grounds required, and the fact that after all

the pieces had to be used in a damp state. A current of air has been suggested as an agent for separating, or, as it were, winnowing the bits. Another authority on the subject states that the amount of incombustible matter in the cinder amounts to 10.5 per cent by volume, or 26.7 per cent by weight.

CEMENTING METAL TO GLASS.

TAKE two parts finely powdered white litharge, and one part dry white-lead, mix intimately, and work up with boiled linseed oil and lac copal to a stiff dough. One part of copal is taken to three parts boiled oil, and enough litharge and white-lead added to make a dough similar to putty. The under side of the metal is filled with the cement, and then pressed upon the glass, the excess of cement being scraped off with any sort of instrument. It dries quickly and holds firmly.

THE DEAD PRESERVED LIKE WAX.

THE Brunetti method for the preservation of the dead consists of several processes: 1. The circulatory system is cleared thoroughly out by washing with cold water till it issues quite clear from the body. This may occupy two to five hours. 2. Alcohol is injected so as to abstract as much water as possible. This occupies about a quarter of an hour. 3. Ether is then injected to abstract the fatty matters. This occupies two to ten hours. 4. A strong solution of tannin is then injected. This occupies for imbibition two to ten hours. 5. The body is then dried in a current of warm air passed over heated chloride of calcium. This may occupy two to five hours. The body is then perfectly preserved, and resists decay. The Italians are said to exhibit specimens which are as hard as stone and retain the shape perfectly, and are equal to the best wax models.

A more simple form of preparation for injection, well suited for anatomical purposes, consists of glycerine, 14 parts; soft sugar, 2 parts; nitrate of potash, 1 part. It is found that, after saturation for some days in this solution, the parts become comparatively indestructible, and change neither in size nor figure.

MANUFACTURE OF PAPER.

BY V. E. KEEGAU, Boston, Mass.—Instead of boiling the wood or other fibrous substance with caustic alkali, the author digests it under a high pressure. Pieces of wood, half an inch thick and from six to twelve inches long, are placed in a cylinder of iron which is filled with caustic soda of 20°; the liquid is submitted to a pressure of

50 lbs. on the square inch for half an hour. The wood is then heated, by means of steam, to about 300° F. The products resulting from the action of the caustic soda on the resin of the wood are soluble, and may be washed out by soaking the wood in water. It may then be transferred to the pulp machine. The soda may be used again, as but little resin, etc., is dissolved out.

CLARIFYING BEER.

OF the thousand and one methods proposed for this purpose, one of the latest is that of Mr. Garton, and consists in the use of phosphate of lime. The process is as follows: A very concentrated solution of phosphate of soda is first put into the wort, and then gypsum or chloride of calcium and slaked lime are added. Instead of the soda salt, phosphoric acid or some soluble phosphate of lime may be employed. This clarifier can be used at any stage of the process, either before or after fermentation. The same process is also recommended for other fermented liquors.

ENGLISH GLAZE FOR EARTHENWARE.

THE glaze is fixed on a light yellow piece of ware of great uniformity and porosity, and of a fire-proof clay. It is of a dark violet-brown color, and somewhat translucent, of extraordinary lustre, and free from all flaws.

Quartz or glazing sand, 28 parts, silver litharge, 40 parts, pipeclay, 18 parts, best manganese oxide, 9 parts, chalk, 5 parts.

In order to produce the uniformity and beauty of color as in the English ware, the materials were melted into a frit first, and then ground finely. The burning of the frit can be easily accomplished in a potter's oven furnished with a cover. (36)

A DURABLE PASTE.

FOUR parts by weight of glue are allowed to soften in 15 parts of cold water for some hours, and then moderately heated till the solution becomes quite clear. Sixty-five parts of boiling water are now added with stirring. In another vessel 30 parts of starch-paste are stirred up with 20 parts of cold water, so that a thin milky fluid is obtained without lumps. Into this the boiling glue solution is poured, with constant stirring, and the whole is kept at the boiling temperature. After cooling, 10 drops of carbolic acid are added to the paste. This paste is of extraordinary adhesive power, and may be used for leather, paper, or cardboard with great success. It must be preserved in closed bottles to prevent evaporation of the water, and will, in this way, keep good for years.

DYEING FABRICS.

A NEW dyeing compound proposed by F. G. Graupner, of Evansville, Ind., consists of a base formed by dissolving and combining thirteen pounds of anvil dust (oxyduloid of iron) with twenty-four pounds of muriatic acid, evaporating the mixture to half its bulk, cooling, settling, and decanting the clear liquid. This base is added to quercitron water and extract of logwood, and the liquor boiled for fifteen minutes. The material to be dyed should be immersed in the boiling liquor for about twenty seconds, then wrung out and immersed in a vat containing about five hundred pounds of warm water, in which has been dissolved one pound of bichromate of potash, after which it is ready for starching and finishing.

RECOVERING FAT AND COLOR FROM WASTE WASH LIQUORS.

A PROCESS for the above, suggested by Messrs. Thom & Stenhouse, of London, consists in treating the waste soap-liquor with a solution of muriate of lime and adding milk of lime until free lime remains in the mixture. After mixing thoroughly and settling, the supernatant liquor is drawn off. The precipitate, containing the fatty and coloring matter, is then treated with sufficient muriatic acid to decompose the fatty matter, but not the coloring; the whole is then strained through flannel, and the fatty and coloring matter left on the strainer are heated to melt and agglutinate the colored fatty substance, then cooled and pressed in bags to remove any watery solutions left by the first straining. The substance removed from the bag may be further heated to remove any remaining water, and the color combined with the fat may be separated by heat and pressure, or by treatment with hydro-carbons as a solvent.

COLORS ON TEXTILE FABRICS.

BY L. GABBA.—The author remarks that, although dyers can occasionally guess the nature of the coloring matter employed in dyeing a fabric, yet they are very likely to err, so that it would be much better to have a methodical process for determining the nature of the coloring matters, similar to that employed in inorganic analysis. Insoluble aniline blue is changed by soda to a brownish red, whilst the soluble blue becomes colorless; azuline under similar circumstances changes to violet. In mixed vat and logwood blues, acids (other than nitric acid) destroy the latter and leave the former unchanged. When mixtures of Saxony and Prussian blue are treated with hypochlorites, the former is destroyed and the latter left.

A mixture of indigo and Prussian blue acquires a greenish shade when treated with soda, owing to the Prussian blue changing to yellow. Molybdenum blue is recognized by the ash of the fabric containing molybdic acid and tin whilst ultramarine becomes colorless and evolves sulphureted hydrogen when treated with an acid. (32)

DYEING WOOL WITH ANILINE GREEN.

As aniline green, unlike most other aniline dyes, appears to possess but little affinity for wool, the author proposes to mordant it with electro-positive sulphur precipitated from a bath of sodium thiosulphate containing a little alum, by the addition of an acid; sulphur deposited from its solution in carbon disulphide, or precipitated from the polysulphides by an acid, can not be used; moreover, the wool, before mordanting, should be cleansed, and treated with dilute hydrochloric acid to remove any metallic salts which would otherwise give a brown shade, from formation of metallic sulphides. The wool is dyed in the usual way in a solution of the green in hot water; the shade can be rendered more or less yellow by the use of picric acid, adding to the bath at the same time some acetate of zinc or acetate of soda, accordingly as a yellow or a blue green is required. Mixed fabrics of wool and cotton can be dyed by mordanting first with sulphur and then with sumach.

NEW FUCHSINE PURPLE DYE FOR COTTON.

TEN pounds of cotton-yarn are steeped for several hours in a hot mixture of 1½ lbs. turmeric and ½ lb. good sumach; ½–¾ lb. sulphuric acid are then added, and the yarn is drawn through the solution several times, and washed well. The yellow yarn is now dipped into a warm fuchsine bath; or turmeric with sulphuric acid may be first used, succeeded by immersion in tannin solution, and followed by the fuchsine bath. A beautiful purple color is produced.

ANTHRACENE BLUE.

BY F. SPRINGMUHL.—This new coloring matter is a by-product of the manufacture of alizarine; it has yet only been prepared in small quantity. The color is soluble in water, and dyes silk, wool, and cotton of a splendid and permanent blue.

ALUMINIUM GOLD-PURPLE.

BY H. SCHWARZ.—The author has obtained a clear rose-purple color upon porcelain, by mixing a soda-solution of alumina with gold chloride. Alumina and gold oxide were precipitated in the finely divided state. This precipitate was dried and burned into porcelain.

BLUE DYEING.

By Grafe.—The oxalates are known to prevent the precipitation of Prussian blue. By mixing the solution of an iron salt, therefore, with a neutral oxalate and potassium ferrocyanide, a clear bluish-green solution is obtained. Goods immersed in this solution, and then, without wringing, dipped into water acidified with hydrochloric acid and containing a little tin chloride, are dyed blue immediately.

Testing Olive-Oil.—Professor Palmieri, of Naples, has lately constructed an electrical apparatus of great delicacy and ingenuity, the object of which is to detect the admixture of other oils with that of the pure olive. The instrument is founded on the fact of the variability in the powers of conduction possessed by the various oils, olive being lowest in the scale. The wires of a battery are brought to a small elongated vessel containing the oil to be examined, and an electrometer being attached, the degree of conductivity can be read off on a scale. The instrument, it is said, can detect any of the usual adulterants with the utmost nicety.

Effect of Calcareous Waters in Cleansing, Rinsing, and Dyeing Wools, (P. Havrez.)—In cleansing and rinsing, the lime with the suint of the wool forms an insoluble lime-soap, which operates against the effects which the dyer wishes to produce. With woad, logwood, and redwood, the presence of lime in the waters is no serious disadvantage. With woad, a little tartar assists the development of the color if the water is calcareous. With quercitron, fustic, and madder, calcareous waters are detrimental, but they are especially so with cochineal and scarlets mordanted with tinsalt, the effect being to "sadden" the color.

Dyeing Wools and Cloths in the Indigo Vat, (M. de Vinant.)—To start the vat, a sufficient quantity of water is introduced, which is heated to 54° C., and then there is introduced—

Ground indigo	2 kil.
Crystallized sodic carbonate.....	15 "
Bran.....	30 "

and, after twelve hours' repose—

Perfectly slaked lime.....	2 "

The lime is used to prevent the fermentation from going too far.

Removing Ink-Spots from Delicate Colors.—When oxalic acid or chloride of lime could not be used without injury to the color, a concentrated solution of sodium pyrophosphate is recommended. (97)

BLACK PRINTING-COLOR FOR LINEN AND COTTON FABRICS.

By R. Bottger.—The fluid vegetable fat contained in the juice of the anacardium nut may be used to advantage in printing linen and cotton fabrics. By treatment with acids or alkalies, this color does not suffer the slightest diminution of intensity; indeed with the latter it gains notably. The coarsely powdered nuts are digested for some time with petroleum spirit in a closed glass at a moderate heat, and the very volatile solvent then allowed to vaporate. The tint first obtained on printing is a dusky brownish yellow, changing to deep black when the fabric is wetted with ammonia solution or lime-water. Strong solution of calcium chloride appears to affect the color slightly, but solution of potassium cyanide, caustic alkalies, and acids of all kinds do not seem to affect it in the slightest degree. (36)

MORDANTING WOOLENS WITH ALUM.

By R. Harvey.—The object of this paper is to show that in mordanting woolens with alum, a strong solution must be avoided, and that only small quantities of the alum must be used, as with large quantities the alumina hydrate deposited in the fibres is redissolved, and the woolen is thus found not to be so deeply or so easily colored as when small quantities are employed. The amount of alum recommended by the author is one tenth of the quantity of woolen to be colored. He found that even after washing the woolen with weak nitric-acid solution to remove any alkali derived from the soap with which it had been washed, or lime from the water, a decomposition of the alum took place and alumina hydrate was deposited in the fibre of the material. This decomposition of the alum had evidently been effected by the fibre of the woolen itself. Reiman's theory is based upon the view that the alum was split up into its single elements by dialysis.

Basic aluminium sulphate separates in the fibre of the material by the decomposition of the aluminium sulphate of the alum, whilst the excess of acid remains in the water, and in the case of a weak alum solution, is too dilute to effect the solution of the basic sulphate. (36)

INDULIN INK.

Coupier and Collin's blue-black, known by the name of Indulin, dissolved in water in the ratio of 20 parts to 1000 of water, forms a writing-ink of a good color, which it retains when treated with chemical agents. It does not corrode steel pens, and remains liquid. This ink is especially recommended for schools, as it can be washed out with water.

IODINE GREEN ON LINEN.

EIGHT pounds of sumach are boiled in water, and the fabric is placed in the solution over night. It is then mordanted in a solution of aluminium acetate, made by adding a solution of 1 pound of alum to one of 1½ pounds lead acetate. The material is now dyed in the iodine-green, which is obtained by dissolving this coloring matter in the form of powder, which must be of good quality. If requisite, the shade may be modified by subsequent treatment in a weak picric acid bath; 60 pounds of yarn require 1 pound of the iodine-green powder.

PREPARING WATER-COLORS.

A CONVENIENT method of preparing water-colors for artistic and other uses, suggested by E. L. Molyneux, consists in preparing a sheet of card-board in such a manner that it will not absorb color, and then painting it with any desired color prepared with sufficient sizing. When one coat is dry, another is added, and so on until a mass of sufficient thickness has been formed. These sheets are cut up and the pieces may then be pasted on different sheets, each sheet containing as many different colors or pieces as desired. In using these tablets, the amount of color required may be taken off with a brush moistened with water, thus dispensing with the use of the slabs or tiles usually required in grinding the cakes.

INDESTRUCTIBLE COLORS.

ONE drachm of aniline black is rubbed with a mixture of sixty drops of concentrated hydrochloric acid and three-quarters of an ounce of alcohol. The deep blue solution obtained is diluted with a hot solution of one and a half drams of gum-arabic in three ounces of water. This color does not attack steel pens, and is unaffected by concentrated mineral acids or strong alkalies. If the aniline-black solution, instead of being diluted with gum-water, be treated with a solution of between a half and three quarters of an ounce of shellac in three ounces of alcohol, an aniline-lake is obtained, which is remarkable for producing a very deep black color on brass or leather.

VERMILION ANHYDROUS CUPROUS OXIDE.

BY R. BOTTGER.—Two parts of potassium hydrate are dissolved in 16 parts of water in a porcelain basin, 1 pt. of starch sugar is added, and then 1 pt. of cupric tartrate; the mixure is heated to about 60° till it assumes a bright and deep red color, and then immediately poured into a considerable quantity of well-water previously de-aërated by boiling. (32)

ANILINE COLORS IN COLLODION.

By F. Springmuhl.—Collodion wool is treated in a closed flask with a mixture of 2 volumes ether and 1 volume alcohol of 95 per cent till a thick but clear solution is obtained. To this, ether is added to the desired point of dilution, which must be such that the liquid can be poured on a glass plate, and by inclining the plate can be made to distribute and spread itself thereon. The aniline color is then dissolved in pure alcohol, the volume of which must be half that of the ether additionally mixed with the collodion. The color solution is then shaken up with the collodion solution to mix it thoroughly. This collodion lake can be kept as long as desired. When it is poured on glass, a transparent film remains in about two minutes, far exceeding in brilliancy and uniformity the "aniline-lake" coating described in a recent treatise. If the collodion is of the right degree of concentration, the film will adhere tolerably fast to perfectly smooth objects, but most persistently to glass and mica. Paper is beautifully colored by this lake, but the solution must be as fluid as possible. Beautiful effects may also be produced on photographs, engravings, etc. (32)

CLARIFYING VARNISH, ETC.

A method of clarifying liquids designed by F. Kersting, of Washington, by which it is stated that the time used in removing impurities from varnishes by settling may be reduced from several months to forty-eight hours, is as follows: Mix with every ten gallons of varnish one half-pound each of powdered marble-dust and burnt oyster-shells. All the impurities in the varnish will, it is stated, be attracted by and adhere to the oyster-shell dust, and the weight of the marble-dust mixed therewith precipitates every floating particle to the bottom of the receptacle containing the varnish. This process may be also applied to the clarification of turpentine, oils, and molasses.

WHITE PAINT FOR METALLIC SURFACES.

By Dr. Sels.—Pure, finely-powdered zinc-white (zinc-oxide) is mixed with a solution of soda water-glass of 40° to 50° Baumé, to the right consistency for an oil-color. The metallic surface to be painted is well cleaned and washed with hydrochloric acid, and afterward with water, and the paint is laid on in successive coatings. Not too much paint must be mixed at a time, as it will become thick and dry on standing, on account of chemical combinations setting in. A surface thus painted preserves a dazzling white appearance. By addition of mineral colors, various tints may be obtained.

COLORING PARAFFINE AND OTHER MATERIALS BLACK.

BY R. BOTTGER.—The materials (wax, stearic acid, paraffine, etc.) are melted, and digested for some minutes with coarsely powdered or bruised anacardium nuts, (the fruit of "*Anacardium Orientale.*") This nut contains a black fluid vegetable fat, which combines intimately with the fused candle materials, and does not prejudicially affect the illuminating power of the candles.

PREPARATION OF ALCOHOLIC LAKES.

BY A. MORELL.—Amongst the many spirit varnishes, the gold varnishes are especially defective in not adhering firmly enough to a metallic surface.

To remedy this, pure crystallized boric acid is dissolved in the varnish to the extent of half a part in 100 parts of the varnish. Thus improved, the varnish poured upon a plate forms a hard glassy coating, so firmly adherent and hard as to be impenetrable on scratching with the finger-nail.

The above proportion of boric acid must be carefully adhered to, or the varnish loses its intensity of color.

(36)

WOOD-STAINING.

1. *Ordinary lack Staining.*—Brazil wood, powdered gall-nuts, and alum are boiled in water until a black color is obtained; the liquid is filtered and spread upon the wood, which is then covered with a preparation of iron filings heated for some days with vitriol and vinegar. It then becomes of a fine black color.

2. *Staining Fine Woods.*—Applicable especially to apple, pear, and walnut woods. 4 oz. gall-nuts, 1 oz. powdered log-wood, ½ oz. vitriol, and ½ oz. verdigris are boiled with water, and the solution, filtered hot, is applied to the wood, which is then coated with a solution of 1 oz. fine iron-filings dissolved in wine vinegar.

Inlaid wood is treated with a liquid prepared by mixing ½ oz. sal-ammoniac with a quantity of steel filings, adding vinegar, and leaving the mixture for fourteen days in a warm oven. In this liquid the wood is boiled, and then allowed to remain therein for three days; it is then similarly treated with a mixture of gall-nuts and Brazil-wood decoction. (32)

A BLUE STAMP COLOR.

BY R. BOETTGER.—Bleu de Lyons is dissolved to saturation with the aid of gentle heat in concentrated glycerine, some Thénand's blue added, and the liquid thickened with finely powdered gum-arabic.

A NEW PROCESS FOR COLORING IVORY, GELATINE, FEATHERS, ETC., A FINE RED.

BY C. PUSCHER.—When picric acid is mixed with a solution of magenta, decomposition takes place. But by adding to each, before mixing, a quantity of ammonia, a deep yellow solution is obtained which colors wood, leather, silk, etc., a brilliant red.

A NEW MORDANT, suggested by Messrs. Burgess and La Rhett, of Providence, consists of sodium chloride and binoxalate of potash, varying in proportions from thirteen parts of the first, and three of the last, to sixteen parts and one part, according to the colors being dyed.

COLORS OF BRICKS.

BY H. SEGER.—The author considers: (1) the color of the mass of the brick, as seen by the fracture. The chief coloring ingredients are iron and manganese oxides. The former produces in the brick colors varying from light red to red-black, depending upon the amount of the iron oxide present, and also on the temperature to which the bricks are heated. If calcium carbonate be also present, silicates of iron, aluminium, and calcium are produced on heating, the color of which changes as the temperature increases, from light red to yellow, then to flesh color, and eventually to yellow or yellowish green. Manganese oxide is generally present in quantities so small as not materially to influence the color of the bricks.

(2.) The color of the brick near the exterior, in as far as this differs from the color of the mass of the brick.

The colors here are much more uncertain than those of the mass of the brick.

They are easily affected by the temperature, the gases from the fuel, etc. The surface of the brick often shows stripes or blotches of a red color, while the inner part is yellow. These marks are caused by there being an insufficiency of lime to combine with the silicic acid, and so to form a silicate which can take up the greater part of the ferric oxide. The gases from the fuel, especially if coal is used, contain more or less sulphuric acid, which combines with the lime, thus fixing it as gypsum.

(3.) Substances derived from foreign sources sometimes cause the outer part of the bricks to be marked or colored. These substances are either soluble salts formed by the action of the wash-water upon the clay, (especially when this contains sulphates or chlorides,) which remain on the bricks when these are dried, or they are part of the ashes from the furnace which are caught up by the wet surfaces of the bricks and are there fixed on drying.

(4.) After the bricks have been employed for building purposes, marks sometimes appear on their exteriors. These are caused either by the action of atmospheric moisture on soluble salts in the bricks, especially sodium bicarbonate, sodium and magnesium sulphates and chlorides, (the presence of these salts being due to insufficiency of burning,) or by the growth of small vegetable organisms on the bricks. These vegetable growths seem to confine themselves to light-colored brick; no sufficient means for their removal is yet known. (32, 36)

ENAMELING PUMP-CYLINDERS.

CAST-IRON cylinders can be enameled in the following manner, according to Amtmann: To separate the graphite, they are laid for two or three hours in an acid bath, and then well washed off with water and brushes. A mass, consisting of 34 parts quartz, 15 parts borax, and 2 parts carbonate of soda, is then uniformly spread on; the pipes are then heated for ten minutes in a muffle of a semicircular cross section of the width of 36 inches, and 9 feet in length. They are then withdrawn, cooled, and coated uniformly with a glazing composition consisting of 34 parts felspar, 19 parts quartz, 24 parts borax, 16 parts oxide of tin, 4 parts fluor-spar, 9 parts carbonate of soda, and 3 parts nitre. The mass is prepared by melting the materials together in a crucible and then grinding them in a mill, with the addition of water. After the cylinders have been covered with the glazing, they are heated in a muffle to a white heat for twenty minutes, whereupon they are withdrawn and coated with coal-tar before they are quite cold. In practice, they have been subjected to a pressure and showed no cracks, proving that the combination of the materials was thorough and complete. Attempts to glaze lead pipes have hitherto been unsuccessful.

LACKERS.

LACKERS are used upon polished metals and wood, to impart the appearance of gold. They are wanted of different depths and shades of colors. The following are recipes for their preparation:

1. DEEP GOLDEN-COLORED LACKER.—Seed-lac, 3 ounces; turmeric, 1 ounce; dragon's blood, ½ ounce; alcohol, 1 pint. Digest for a week, frequently shaking. Decant and filter.

2. GOLDEN-COLORED LACKER.—Ground turmeric, 1 pound; gamboge, 1½ ounces; gum-sandarac, 3½ pounds; shellac, ¼ pound, (all in powder;) rectified spirits of wine, 2 gallons. Dissolve, strain, and add 1 pint of turpentine varnish.

3. RED-COLORED LACKER.—Spanish annatto, 3 pounds; dragon's blood, 1 pound; gum-sandarac, 3½ pounds; rectified spirits, 2 gallons; turpentine varnish, 1 quart. Dissolve and mix as the last.

4. PALE BRASS-COLORED LACKER.—Gamboge, cut small, 1 ounce; Cape aloes, ditto, 3 ounces; pale shellac, 1 pound; rectified spirits, 2 gallons. Dissolve and mix as No. 2.

5. Seed-lac, dragon's blood, annatto, and gamboge, of each ½ pound; saffron, 1 ounce; rectified spirits of wine, 10 pints. Dissolve and mix as No. 2.

The following recipes make most excellent lackers:

1. GOLD LACKER.—Put into a clean four-gallon tin 1 pound ground turmeric, 1½ ounces of powdered gamboge, 3½ ounces of powdered gum-sandarac, ½ pound of shellac, and 2 gallons of spirits of wine. After being agitated, dissolved, and strained, add 1 pint of turpentine varnish well mixed.

2. RED LACKER.—Two gallons of spirits of wine, 1 pound of dragon's blood, 3 pounds of Spanish annatto, 4½ pounds of gum-sandarac, 2 pints of turpentine. Made as No. 1 lacker.

3. PALE BRASS LACKER.—Two gallons of spirits of wine, 3 ounces of Cape aloes cut small, 1 pound of fine pale shellac, 1 ounce of gamboge, cut small, no turpentine varnish. Made exactly as before.

But observe that those who make lackers frequently want some paler, and some darker, and sometimes inclining more to the particular tint of certain of the component ingredients. Therefore, if a four-ounce vial of a strong solution of each ingredient be prepared, a lacker of any tint can be procured at any time.

4. PALE TIN LACKER.—Strongest alcohol, 4 ounces; powdered turmeric, 2 drachms; hay saffron, 1 scruple; dragon's blood, in powder, 2 scruples; red saunders, ½ scruple. Infuse this mixture in the cold for forty-eight hours, pour off the clear, and strain the rest; then add powdered shellac, ½ ounce; sandarac, 1 drachm; mastic, 1 drachm; Canada balsam, 1 drachm. Dissolve this in the cold by frequent agitation, laying the bottle on its side, to present a greater surface to the alcohol. When dissolved, add 40 drops of spirits of turpentine.

5. ANOTHER DEEP GOLD LACKER.—Strongest alcohol, 4 ounces; Spanish annatto, 8 grains; powdered turmeric, 2 drachms; red saunders, 12 grains. Infuse and add shellac, etc., as to the pale tin lacker; and, when dissolved, add 30 drops of spirits of turpentine.

Lacker should always stand till it is quite fine before it is used.

MANUFACTURE OF WHITE-LEAD.

INSTEAD of vaporizing the acetic acid by direct heat in the usual manner, A. P. Meylert, of New-Britain, Ct., proposes passing the carbonic acid gas through the acid so as to compel a partial vaporization of the latter, and to carry over into the corroding-chamber only so much as can be economically used, which, he states, possesses important advantages over the old process in the saving of cost of apparatus, fuel, and attendance, besides producing a better quality of lead.

TREATING OIL AND OIL-WELLS.

J. J. LOONEY, of St. Petersburg, Pa., states that if the ordinary crude petroleum be treated with a sufficient quantity of a mixture of benzine and sulphuric acid previous to distillation to dissolve all hard resinous substances, paraffine, etc., that said crude oil will, when distilled, yield a considerably greater quantity of refined oil. He also states that an oil-well that has become clogged with paraffine may be freed from it by first pouring down the well a solution of potassa, and then sufficient sulphuric acid to generate heat enough to melt the paraffine, in which condition it may be kept (until pumped out) by adding a mixture of benzine and sulphuric acid.

SOLID INKS.—E. Roy prepares various qualities of inks in the solid state; by merely placing a small quantity of the powder in water, ink for writing is immediately obtained. One variety, styled *indelible ink*, is stated to resist the action of the most energetic chemical reagents. It appears to consist mainly of charcoal and glycerine. For traveling and other purposes, the possibility of dispensing with liquid ink renders these substances valuable.—*Revue Hebdomadaire.*

MORDANT FOR ANILINE COLORS ON COTTON.—Until recently, aniline colors have been fixed on cotton by treatment with animal matter, as albumen, gelatine, or with galls, sumach, tannin, as well as by the use of mordants of acetate of alumina, soap, and oil. Dr. Reimann, however, directs attention to the peculiar power possessed by starch, of abstracting aniline colors from solutions; this not being due to the gluten it contains, since this property is shared equally by wheat and potato starch; and he founds upon this a beautiful method for fixing aniline colors on cotton. It is immaterial whether the color is attracted by the starch suspended in the liquid or attached to the fibre. If the cotton is saturated with a thin paste of potato or wheat starch, and then steeped in a dye-bath of aniline color, it will receive the corresponding shade.

A CLEAR, FLEXIBLE VARNISH.—Puscher recommends a solution of alum soap in oil of turpentine as a specially advantageous varnish for metallic objects which are exposed to high temperatures. Such a varnish does not possess the brilliancy of damar varnish, but it has greater flexibility and resists heat better. The alum soap is prepared by adding a solution of alum to a boiling soap solution as long as a precipitate ensues, washing the latter, and drying. This alum soap is transparent, like glycerine soap, and soluble, in all proportions, in oil of turpentine. —*Polyt. Centralbl.*

MANUFACTURE OF CHLORATE OF POTASH.—To manufacture chlorate of potash on a large scale, it has been recommended by W. Hunt to adopt the following method: Milk of lime is made to trickle down over bricks placed in a tower, where it comes in contact with a continuous current of chlorine gas. Chlorate of lime is the chief product; and, by treating this with chloride of potassium, chlorate of potash is formed, which can be purified by crystallization.

PHOTOGRAPHIC NEGATIVES.

JOSEPH KIRK, of Newark, N. J., states that by coating a glass plate on both sides with collodion or other suitable chemical film, and then exposing the plate in the usual way, a faint image is produced on the back of the plate which has the effect of blending the highest points of lights gradually with the shadows of the printed photograph, giving a beautiful, soft, and porcelainlike effect, thereby saving considerable labor in retouching. A thinner film should be used in front of the plate than that employed for the back.

IMPROVEMENTS IN PHOTOLITHOGRAPHY.

PAUL uses, in place of the ordinary mixture of gelatine and potassium bichromate, a mixture of equal parts of albumen and saturated solution of bichromate, with which he prepares the paper of the Autotype Company, which is admirably suited to the purpose. After exposure, the unaltered albumen is dissolved out by means of cold water. By this method, a much clearer and sharper image is transferred to the stone than by the usual methods.

HEATING PHOTOGRAPHIC BATHS.

A CONVENIENT device for heating negative baths, designed by H. J. Sunter, of Buffalo, consists of a small boiler with a spout having an extension tube of glass coupled to it, which is inserted into the bath to be heated, the lower end of the tube being turned up to prevent the

steam as it escapes from disturbing the sediment. The boiler is heated by a lamp attachment. The steam issuing from the pipe will not only heat the bath, but it will set free the alcohol and ether absorbed in sensitizing plates coated with collodion. A little aqua ammonia added to the water in the boiler will neutralize any excess of acid contained in the bath.

A FIRM COLLODION.

BY R. BOETTGER.—Collodion cotton is dissolved in a mixture of equal volumes of ether and absolute alcohol and a small quantity of balsam of copaiva added. Spread on glass, it leaves a membrane of extraordinary firmness.

GAS-METERS.

THE diaphragms used in dry gas-meters are usually made of leather, but these are acted upon by the gas in time, and fail to act correctly. To remedy this, Messrs. Schüssler & Dietrich, of New-York, propose to substitute for the leather, diaphragms made from parchment-paper, which is obtained by treating cotton or linen paper with equal parts of sulphuric acid and water for a few minutes, washing thoroughly with water, and then saturating with equal parts of glycerine, acetate of potassa, and water.

USES OF BISULPHIDE OF CARBON.

UNTIL 1850, the only technical application of bisulphide of carbon consisted in vulcanizing and dissolving caoutchouc. Since that time, however, this substance has been applied to a good many purposes. 1. For the complete extraction of fat from bones for the preparation of bone-black. Ten or twelve per cent of fat can be obtained. 2. For the extraction of oil from seeds and olives; large quantities of olive-oil, grape-oil, linseed-oil, hemp-seed oil, palm-oil, and cotton-seed oil are obtained in this manner. 3. For the extraction of sulphur from sulphurous earth (according to Moussu) and of bitumen from bituminous rocks. 4. For separating fat from wool, woolen tissues, and rags from machine shops, by Seyferth's patent. 5. For the extraction af the soluble principles of spices, according to the process of Bonière of Rouen. 5½. For the manufacture of hop extracts, Seeley's process, United States. 6. For the manufacture of yellow prussiate of potash according to Gélis, and of sulpho-cyanide of ammonium for the fabrication of the toys called Pharaoh's serpents. 7. For the preparation of the Fenian or liquid fire, a solution of phosphorus in bisulphide of carbon, with which projectiles for rifled guns are filled. 8. In silver-plating, a small quantity of bisulphide of carbon

is added to the silver bath, so that a brilliant deposit may at once be effected. 9. For killing rats, mice, moths, ground worms, and other vermin. 10. As a motor for steam-engines; all systems of steam-engines, with or without expansion, can be run with bisulphide of carbon, which, as well known, boils at 115° Fah.

BAMBOO-BERRY RUBBER.

IT is stated by E. H. Rogers, of Tuscaloosa, Ga., that a gum resembling caoutchouc may be obtained from a wild berry, locally known as the bamboo-berry, and growing in the States bordering on the Gulf of Mexico. To obtain this gum, the juice of the berries is expressed and separated from the hull, and the latter is subsequently washed, dried, and then passed through a grinding-mill to effectually destroy the cohesion of the hull, pulp, and seed, and the dry pulp being the lightest, is easily separated by a fan, and by proper treatment may be easily vulcanized. The juice extracted may be utilized in making wine.

IMPROVEMENT IN RUBBER COMPOUNDS.

A NEW mixture of the above class suggested by W. A. Torrey, of Montclair, N. J., consists in adding to the ordinary compound of rubber and sulphur a portion (not exceeding an equal quantity) of mica, either in the form of powder or in scales. The mica, it is said, is especially valuable in protecting the rubber from the effects of very hot steam when employed in packing engines, etc.

NEW RUBBER COMPOUND.

THOMAS J. MAYALL, of Boston, states that a hard and metal-like product (possessing some of the characteristics of lead and some of rubber, and yet differing from either) especially suitable for bearings, or bearing-linings, stereotype plates, etc., may be made by combining two parts of rubber, one part of sulphur, and from four to five parts of plumbago, duly mixed together in a heater in the manner usual with rubber compounds, next moulding the articles desired, and then vulcanizing at a temperature of from 312° to 318° F. for seven or eight hours. By adding from a half to one part of whiting to the above, a compound suitable for tool-handles and similar articles may be formed, and, with a larger quantity of plumbago, sticks or rods suitable for carpenters' pencils may be made.

IMPROVEMENT IN EXPLOSIVE COMPOUNDS.

ACCORDING to T. P. Shaffner, of Louisville, gun-cotton and other similar nitrated substances may be made much safer from premature explosion by saturation with water

impregnated with saltpetre or nitrate of soda, or with paraffine, beeswax, resin, sulphur, or any oleaginous or resinous matter. When moist with the first-mentioned article, or when mixed with the others, the cotton may be exploded by fixing in the mass and igniting therein a strong percussion-cap containing about ten grains of fulminate of mercury. The explosion of the cotton will immediately evolve the gases belonging to the other substances.

EXPLOSIVE COMPOUND.

TREAT S. BEACH, of New-York, proposes to make an explosive compound by intimately mixing forty parts of nitrate of potash, forty parts of nitro-glycerine, thirteen parts of wood-fibre, and seven pounds of paraffine or its equivalent. About two parts each of sulphur and charcoal may be added, but it is not regarded as essential.

TINNING, ETC., OF BRASS, COPPER, AND IRON.

BY C. PAUL.—The zinc or iron articles are immersed in a mixture of 1 part sulphuric or nitric acid with 10 parts water; a solution of copper sulphate or acetate is then slowly added. After the deposition of a thin layer of copper, the articles are removed, washed, moistened with a solution of 1 part "tin crystals" in 2 parts water and 2 parts hydrochloric acid, and then shaken up with a mixture of fine chalk and copper-ammonium sulphate, which is prepared by dissolving 1 part copper sulphate in 16 parts water, and adding ammonia until a clear dark blue liquid is obtained.

The articles may now be tinned by immersion in a solution of 1 part tin crystals with 3 parts white argol in water. Brass, copper, or nickel goods, also iron and zinc articles which have been copper-plated, may be silvered by treatment (after thorough cleansing) with a solution of 14 grammes silver in 26 grammes nitric acid, to which is added a solution of 120 grammes potassium cyanide in 1 litre water, and also 28 grammes finely-powdered chalk.

(36)

MANUFACTURE OF ZINC AND LEAD PIGMENTS.

FRANKLIN OSGOOD, of New-York, states that by the following process the skimmings and dross made in zincing or galvanizing may be utilized in making zinc-lead: Take the zinc-dross or skimmings, mix with coal-dust and introduce into any suitable furnace. In another furnace, charge ores of lead, or lead-dross, or a salt of lead, mixing in coal in a like manner; or the metallic materials and the coal may be mixed and charged in one furnace. The fire is then kindled, and as the heat rises, the vaporized metals

pass upward and are drawn through flues by an exhaust, the mixed vapors uniting and forming a combination which may be condensed in chambers or bags in chambers adapted for that purpose, forming what is known as zinc-lead. If the zinc skimmings are "ammoniacal" they should be first deprived of alkali. Any of the known ores of zinc may be used in place of the skimmings or dross, if preferred, by first roasting the same so as to separate any acid.

COPPER-PLATING OF CAST-IRON, MALLEABLE IRON, AND STEEL.

By O. Gaudoin.—1. The articles are dipped into a bath of molten copper, over which is a layer of powdered cryolite and phosphoric acid.

2. The articles are immersed in a molten mixture of cuprous chloride or fluoride with 5 or 6 parts cryolite, together with a little barium chloride (which renders the mixture more fusible) contained in carbon crucible.

3. A solution of 1 per cent copper oxalate with a large excess of potassium binoxalate in 10 to 15 parts of water is made, and into this the thoroughly cleansed articles are dipped.

By the employment of an electric current in processes 2 and 3, a better result is obtained. (32, 36)

Steer's Patent Grate.—Messrs. A. Steer & Co., of Upper Thames street, have invented and are manufacturing a new grate, which economizes fuel and utilizes heat in a very satisfactory manner. We have had one fixed in our office, and from experience believe that all the advantages claimed by the inventors are realized. The grate projects from the chimney-piece instead of being recessed like an ordinary grate; the smoke and heat ascend to the top, and then descend the side-flues, which are inside the grate, and pass away at the back. The artistic effect of the grate is also very superior to that of the ordinary form. We believe Mr. Robert Rawlinson has expressed his conviction that this grate is one of the best yet introduced for effecting a saving in fuel and preventing the heat from passing up the chimney instead of into the room, and as far as our present experience goes, we indorse his opinion.

STEEL BARS INSTEAD OF BELLS.

Steel bars produce a very pure, distinct, and melodious sound, and possess many advantages over church bells of moderate size. In Germany, they are in some measure supplanting bells in church steeples, and an English publication, the "Choir," advocates their general use, on the ground that while in point of sonorousness they are equal

to the common bell, in certain other respects they are to be preferred to it. Thus, their weight will be light in comparison with the ponderous engines they are to replace. They will not burden the steeple so much, and consequently will give more scope for architectural design. Their winding and hanging up will not be so difficult, dangerous, and expensive. They are not liable to crack, as is the case with bells, and are therefore adapted for use in any climate. They can be operated by a simple mechanical contrivance.

The cost of these bars is so low that three or four of them, forming a peal, whose weight would not exceed one hundred pounds, could be manufactured in England for fifty or sixty dollars, whereas three bells of the same power would cost five times as much. They can be made of any dimension, weight, or power of sound. Every note or harmony can be produced more easily, and the tuning is obtained more precisely, than in cast bells. Of course these bars are also adapted for use wherever bells are now employed. (116)

WIRE-DRAWING.

A NEW method of wire-drawing, suggested by Messrs. J. & E. Woods, of Warrington, England, consists in arranging four draw-plates, with drums intervening, around which the wire is given three or four turns as it passes from one plate to the next. The drums have their speed increased from the first to the last to provide for the elongation of the wire at each draw-plate. By this arrangement, the wire is passed automatically through as many draw-plates as constitute the number employed in the apparatus.

MANUFACTURE OF GLUE.

TO avoid the many difficulties experienced from the changes of the atmosphere in drying glue by the usual method, O. S. Follett, of Montclair, N. J., proposes the drying of the jelly by placing it in a close box or chamber containing a water-absorbent, such as chloride of calcium, etc.

MAKING SCREW-NUTS.

NUTS for bolts are usually punched from metal in such a manner that the grain crosses them diametrically, which causes them to split comparatively easy in one direction. To overcome this splitting tendency, W. Van Anden, of Poughkeepsie, suggests the formation of nuts from sections of rods twisted so as to give the grain of the iron a spiral direction, thereby forming a nut with the grain around it.

PNEUMATIC ICE-MACHINES.

By J. Armengaud.—In air frigorific machines, the source of cold is obtained by means of air, which is first condensed, then cooled, and subsequently allowed to expand against a piston in such a manner as to exercise a certain exterior mechanical force which can be utilized in assisting to compress fresh quantities of air. The motive force required to work such a machine is the difference between the force expended in condensing the air and that restored on its expansion. With regard to the manner of cooling the air which has become heated by compression, the author prefers to inject water into the cylinder of the pump during the compression; but, whatever method may be adopted, "the effective motive power required for the production of cold by the mechanical expansion of gases depends only, for a given mass, on the absolute initial temperature of the gas on entering the machine, and the degree chosen for the expansion." Moreover, the calorific power of the machine in respect of the motive power is independent of the nature of the gas. The motive power required when 2 is the degree of expansion, and the cooling is performed during the compression of the gas, is only one half of what it would be if cooled afterward. As the motive power required increases with the degree of expansion, it is advisable to have this as low as possible compatibly with the intensity of cold which it is desired to attain: the number 2 is that which seems to be preferable. At this degree, and cooling the air during compression, one horse-power, of 270,000 kilogramme metres per hour, is theoretically able to convert 41 kilogrammes of water at 20° into ice. (4)

FROZEN DYNAMITE.

Dynamite in our severe winters is usually frozen solid, and when in such state is comparatively valueless, as in thawing for use it becomes injured and sometimes ignites; but it is stated by Thomas Varney, of San Francisco, that by granulating it as freezing takes place, and keeping it in this condition, it may be transported, handled, or poured and rammed into bore-holes with entire safety and convenience. This freezing the dynamite in grains may be readily accomplished by passing it through a coarse sieve after it is manufactured, but just before it congeals, and allowing it to fall loosely and lie undisturbed during its exposure to a freezing temperature. The particles will slightly adhere, but may be readily separated by stirring. Dynamite so frozen will readily explode by the ordinary means, but the cap should have about three times the usual quantity of fulminate.

WATER-PROOF MATCHES.

OLIVER H. HICKS, of Baltimore, Md., states that if matches be headed with the friction paste *first*, and then dipped in paraffine, they will be practically water-proof, so much so, that he has soaked matches made in this manner in water from twelve to eighteen hours and ignited and burnt them directly afterward.

NOVEL BURGLAR-PROOF SAFES.

A NEW way to foil burglars, proposed by George Little, of Rutherford Park, N. J., consists in providing a safe with recesses for the reception of chemicals (such, for instance, as phosphide of calcium) and water. These are separated by a friable substance which will break by any jar, strain, or concussion to which the safe is subjected by the burglar in attempting to open it, and allow the chemicals to mix and produce a light together with a penetrating vapor or smoke, the former giving an alarm, and the latter forcing the burglar to retreat.

MANUFACTURE OF SUGAR.

WHEN thoroughly refined moist granular sugar has been pressed, the dried product is not as firm and solid as that obtained from sugar not so well refined. A. F. W. Paitz, of Oakland, Cal., therefore proposes to add to the "washing liquor" last introduced into the centrifugal machine a small quantity of dextrine—about one part to from two hundred to five hundred parts of the water—which will render the sugar much more adhesive.

A SUBSTITUTE FOR PARCHMENT.

PARCHMENT-PAPER has several properties in common with animal membrane. It is obtained by the action of sulphuric acid or chloride-of-zinc solution on unsized paper. When sulphuric acid is employed, the best solution is one kilogramme (2.20485 pounds) English concentrated sulphuric acid to 125 grammes (about 4.4 ounces) of water. The paper is dipped into the acid so as to moisten both sides uniformly. The length of time it is to remain in the bath depends on its own thickness and density. The minimum time for the ordinary unsized paper of commerce is 5 seconds, the maximum 20. When the acid has acted a sufficient length of time, the paper is first dipped in cold water, then in dilute ammonia, again in water, to remove the acid, and finally it is dried. When it is left to itself to dry, it becomes shriveled, and has a bad appearance. To guard against this, the following process is adopted: An endless strip of paper is passed by machinery first through a vat of sulphuric acid, and then through water, ammonia,

and water again; next a cloth-covered roller deprives it of a portion of the water, and finally it is pressed and smoothed out by means of polished heated cylinders.

When properly manufactured, parchment-paper has the same color and translucency as animal parchment, its structure having undergone a change from fibrous to corneous. In point of cohesion and hygroscopicity, it is very much like common parchment. When dipped in water, it becomes soft and flaccid. It is impermeable to liquids, except by dialysis. These qualities render parchment-paper specially suitable for diplomas, important papers, and in general for documents which it is desirable to preserve. As compared with ordinary parchment, this paper possesses the advantage that it is very little liable to be attacked by insects. Then, too, the characters inscribed on it can not be effaced without difficulty, and when effaced, can not be replaced by others—a perfect guarantee against all kinds of falsification. By reason of its firmness and durability, it is specially suited for plans and drawings, particularly architectural drawings, which are much exposed to moisture. Further, it might be used for covering books; or books, maps, etc., for use in schools, could be printed on it, and would be very durable. In place of animal membrane, it is well suited for covering jars of fruit, extracts, etc., as also for connecting the parts of distilling and other apparatus. It furnishes excellent casings for sausages. In surgery it is employed instead of linen, oiled cloth, and gutta-percha, for dressing wounds. (77)

NEW GAS FURNACE.

By L. Forquignon and A. Leclerc.—The authors have arranged a small furnace, for use with the ordinary gas blowpipe, by means of which platinum and porcelain crucibles of 15 to 20 c.c. capacity may be quickly raised to a temperature considerably exceeding the melting-point of cast-iron.

The furnace in question is composed of two parts, an interior envelope and a movable covering. The latter, which completely surrounds the internal portion, rests upon a flange adapted to the outside and lower extremity of the interior envelope. Its walls are very thick, the better to retain the heat, and upon its lower edge eight holes are symmetrically placed, in order to allow an outward passage for the heated gases. A knob or ring of iron at the top serves to remove and to replace this covering. The crucible to be heated is held in the centre of the interior portion by a platinum support, which rests upon a small ledge. The source of heat—an ordinary gas blow-

pipe, as before mentioned—is arranged beneath in such a manner that the nozzle of the blowpipe shall be only a few centimetres below the inferior circular orifice; the flame will therefore circulate in the first instance round the crucible, then in the annular space comprised between the interior envelope and the covering, and the products of combustion will finally escape by passing out through the eight openings at the base of the latter. The progress of the heating may be observed by holding a small mirror beneath the arrangement.

With a furnace arranged in the manner above described, the authors have succeeded in melting 40 grammes of cast-iron in less than a quarter of an hour. (4)

NEW METHOD OF COPYING DRAWINGS.

By M. Renault.—It is well known that the oxygen salts of silver impregnating paper or other organic material are easily reduced by copper, hydrogen, or vapor of phosphorus, and that this is not the case with the haloid salts of that metal.

The author of the present paper has applied these facts to the reproduction of engravings, drawings, and designs of that kind.

The sheet of paper on which the drawing is made is placed on the top of a sheet of cardboard which has previously been exposed to vapor of hydrochloric acid, and on the top of the drawing is spread a sheet of paper sensitized with an oxygen-salt of silver. The double nitrate of iron and silver is one of the best for this purpose. The vapors of the hydrochloric acid rising from the pasteboard beneath pass through the paper at all points, except those at which the lines of the picture are found. The oxy-salt in the sensitized paper quickly becomes converted into chloride of silver; but those points at which the hydrochloric acid has not penetrated remain in their old condition. When the paper thus treated is laid on a plate of copper, or exposed to hydrogen or vapor of phosphorus, the unchloridized parts blacken, and a perfect copy of the design is obtained, which may afterward be fixed in the regular way. (4)

ADULTERATION OF WAX WITH TALLOW.

By Hardy.—Wax floats in alcohol of 29°. By observing the strength of the alcohol in which the sample floats, the percentage of wax may be deduced.

If the alcoholometer shows	29.°		the wax contains	100	per cent	wax.
" "	30.63°		" "	75	"	
" "	50.25°		" "	50	"	
" "	60.87°		" "	25	"	
" "	71.50°		" "	0	"	

ALUMINA SOAP.

THIS lake possesses great flexibility. and is superior to all others in being unaffected by a high temperature. Besides being applicable to all kinds of material to be rendered waterproof, this soap in solution may be used with advantage to coat metallic surfaces which have to withstand considerable heat. In the air, articles thus coated dry slowly; if exposed to a temperature of 50°, more quickly. To prepare this soap, a solution of alum or aluminium sulphate is added to a dilute boiling solution of soap, so long as a separation of white hydrated alumina soap takes place. The white precipitate is washed with hot water to remove adhering saline solution, and is heated to remove water. By these means a transparent soap is obtained resembling glycerine soap, soluble in warm oil of turpentine in all proportions. The water may also be driven off by heating with oil of turpentine. When the solution becomes thick and transparent, the lake is ready. For making this alumina soap, a good yellow rosin soap is the best to use. (36)

POLISH FOR FURNITURE.

EIGHT parts of white wax, two parts of rosin, and half a part of Venice turpentine, are melted at a gentle heat. The warm mass, completely melted, is poured into a stone jar, agitated, and six parts of rectified oil of turpentine are added thereto. After 24 hours, the mass having the consistency of soft butter, is ready for use. Before using the paste, the furniture should be washed with soap and water and then well dried.

PICTURES ON EARTHENWARE PLATES.

BY RICHARD JACOBSEN.—Prepared paper is exposed for a sufficient time under a transparent drawing, woodcut, etc., and the excess of chrome-salt removed by washing. The paper is then transferred, picture-side down, to a plate of gypsum. A positive copy is thus obtained from a positive drawing, as only the unaltered gelatine sinks into the gypsum. By replacing the carbon with enamel-colors, designs can be printed on and burned into unglazed porcelain, etc.

FASTENING LEATHER UPON METAL.—One part of crushed nutgalls is digested six hours with eight parts distilled water, and strained. Glue is macerated in its own weight of water for twenty-four hours, and then dissolved. The warm infusion of galls is spread upon the leather, the glue solution upon the roughened surface of the warm metal; the moist leather is pressed upon it and then dried, when it adheres so that it can not be removed without tearing.

CAUSTIC SODA.

AN important improvement has been effected in the manufacture of caustic soda by the introduction of a blast of air through the melted mass. The caustic soda, as prepared from soda-ash by means of lime, is contaminated with carbonate of soda, cyanides, and sulphur compounds; the latter are particularly deleterious in numerous operations, and much attention has been bestowed upon getting rid of them. Formerly some saltpeter was added to the lye and the sulphide of sodium was oxidized to Glauber salts, which was less objectionable, but the process is expensive and the result not satisfactory. W. Hebig, of Gera, Germany, has modified the operation by blowing air through the fused soda, by which the sulphides are oxidized and the cyanides decomposed. The operation is conducted as follows: The soda lye is evaporated in iron kettles, and a point is reached at which the cyanogen and ammonia compounds are decomposed and graphite swims on the top. Finally the contents of the kettle are heated to redness and melted to a thin liquid; while in this condition, a current of air is passed through. Graphite floats on the top, which is sometimes saved, but, owing to its crystalline texture, is not adapted to paint or pencils, and is often burned up as useless. The air-blast is made so strong as to keep the mass in agitation, and is continued until all of the sulphur is oxidized. The operation is then suspended, the air-tube is removed, and the soda poured off the sediment and allowed to solidify. A good product is secured in this way more cheaply than by the saltpetre process. The graphite obtained as an incidental product is quite large in some establishments, and is made up into refractory crucibles.

A NEW WATER AIR-PUMP.

BY C. CHRISTIANSEN.—This is a modification of the well-known aspirator of Johnson. A thick-sided caoutchouc tube attached to a water-tap is pierced a little below with a red-hot needle, and into the aperture thus made is inserted the shorter arm of a glass tube, bent at right angles, the aperture being directed downward. On setting the water running, only a slight suction is perceived until the caoutchouc tube is pinched a little below the end of the glass tube. The point at which the pressure must be made in order to produce the most rapid exhaustion must be found by trial. When the apparatus acts well, the pressure in a vessel connected with the glass tube may be reduced very nearly to the tension of water-vapor at the temperature existing in the vessel. (88)

MANUFACTURE OF GAS.

To save fuel and utilize the tarry deposit in hydraulic mains, F. A. Sabbaton, of Troy, N. Y., proposes to add a syphon to the main which shall carry down the deposit to a funnel arranged in a tube surrounding a steam injector, which carries the tar in a fine spray beneath the retort, where it is burned to assist in heating the latter. The tube surrounding the injector has a register at its outer end to regulate the amount of air passing into the furnace with the steam and tar.

GIANT POWDER.

ONE of the many recent suggestions looking to the safer use of nitro-glycerine is that proposed by Egbert Judson, of San Francisco, which consists in mixing with forty parts of the explosive, sixty parts of a dry mixture made up of forty parts of nitrate of soda, six parts of rosin, six parts of sulphur, and eight parts of infusorial earth or other analogous absorbent substance. This forms a powerful blasting-compound which will not ignite from contact with flame, nor from a blow, but may be readily exploded by the shock given by discharging a cap containing fulminate.

NEW STOVE-POLISHING COMPOUND.

JACOB I. DANFORTH, of Newburyport, Mass., states that a mixture of two parts of copperas, one of bone-black, one of black-lead, and sufficient water to make it of the consistency of cream will produce a polish on a stove or other iron article that is very enduring, and after two applications it will not require polishing again for a long time, as the copperas will produce a jet-black enamel and cause the black-lead to permanently adhere to the iron.

PARISIAN WOOD-VARNISH.—To prepare a good varnish for fancy woods, dissolve one part of good shellac in three to four parts of alcohol of 92 per cent in a water bath, and cautiously add distilled water until a curdy mass separates out, which is collected and pressed between linen; the liquid is filtered through paper, all the alcohol removed by distillation from the water bath, and the resin removed and dried at 100° Centigrade until it ceases to lose weight; it is then dissolved in double its weight of alcohol of at least 96 per cent, and the solution perfumed with lavender oil.

INDESTRUCTIBLE PUTTY.—Boil 4 pounds brown umber in 7 pounds linseed oil for two hours; stir in two ounces of wax; take from the fire and mix in 5½ pounds chalk and 11 pounds white-lead, and incorporate thoroughly. The latter operation is quite essential.

MANUFACTURE OF SULPHURIC ACID.

INSTEAD of the lumps of coke or balls of earthy material usually employed in the towers in which sulphuric acid is condensed, Joseph Saunders, of Brooklyn, N. Y., proposes to use hollow balls of glass about six inches in diameter, arranged with their openings on the top in the tower, in which the gases descend, and the reverse in the tower through which the gases ascend. As these glass balls are not affected by the acid, the annoyances resulting from the friability of the materials previously employed are obviated.

BISULPHIDE OF CARBON FROM GAS-LIME, ETC.

A CHEAP process for obtaining bisulphide of carbon from the materials used in purifying coal-gas, suggested by Julius Kircher, of New-York, consists in heating the refuse lime or iron, in a suitable retort, with an equal quantity of clay, loam, or sand, if the lime only is used. This produces vapor of sulphur, which is conducted over charred or other coal which has been heated to a light-red heat, and vapors of bisulphide of carbon are produced. Or the gas-lime, gas-iron, or similar material, may be mixed with from one tenth to one quarter of its weight of pulverized charred or other coal, then quickly heated until it is raised to a light-red heat, and thus form, in a vaporous condition, the bisulphide of carbon. The vapors formed by either of these methods may be condensed by any of the ordinary modes.

DEODORIZING OIL FROM ACID TAR.

RICHARD GAGGIN, of Erie, Pa., states that a good oil suitable for lubricating purposes, and for use as a substitute for linseed-oil in the manufacture of printers' ink, may be obtained from the acid tar of oil-refineries, by diluting it with benzine, then separating the acid by repeated washings, distilling, and next treating with milk of chloride of lime at a temperature not exceeding 140°. After the oil has been thus treated, the limy sediment is drawn off, and a caustic or carbonated alkali introduced to neutralize any of the remaining chlorides or chlorine. The alkaline sediment is next drawn off, and after the oil has been again washed with water, the process is finished.

CEMENT FOR LEATHER.—Ten parts of carbon disulphide and one part oil of turpentine are mixed, and as much gutta-percha added as will readily dissolve. The surfaces of leather must be freed, with a hot iron, from fat, and the parts once joined should be well pressed until they are firmly united.

FINISHING COTTON AND LINEN GOODS.

INSTEAD of sprinkling with water, it has been recommended to add a hygroscopic salt to the finishing mixture, and calcium chloride is the salt selected as best for the purpose. By hanging the material so prepared for four hours in a cool room, so much moisture is absorbed that it is then ready for calendering. For a mixture of this kind, 100 quarts of the paste and 3 ounces of calcium chloride are recommended.

For the sprinkling process, many arrangements have been devised.

A NEW BLUE.

WHEN phenol is treated with chlorine water, no reaction is observed, and ammonia added to the mixture subsequently, develops no coloration. It is known that aniline, on the contrary, suspended in water, with the addition of a solution of chlorine, takes a rose color, which rapidly becomes purple, violet, and, lastly, brownish red, and that ammonia added at this last juncture increases the brownness. It is no longer the same when a mixture of a drop of phenol and a drop of aniline is submitted to the action of solution of chlorine. A permanent rose-red is obtained, which may be turned to a blue either by ammonia or by the alkalies or alkaline carbonates. Acids restore the original redness. The author concludes that there exists a phenate of phenylamine; that the new body produced in the above reaction is a red acid, forming blue salts; the erythrophenate of soda may be produced by causing hypochlorite of soda to act upon the mixture of phenol and aniline. The blue thus formed is remarkable for its purity and extraordinary tinctorial power. If two drops of the mixture of phenol and aniline be added to two litres of water, and then treated with hypochlorite, the blue in an hour or two becomes so intense that it could be recognized even in 4 litres of water. This reaction may be useful in toxicological researches either for aniline or phenol. The purity and permanence of the blue might render it fit for the use of the dyer, but it will not bear steaming. The extreme facility with which it is reddened by the feeblest acids is likewise an objection. In this respect it far exceeds litmus.—*E. Jacquemin.*

DULL VARNISH.

A VARNISH which does not reflect light is prepared by mixing a solution of resin with some liquid in which resin is insoluble. A mixture of 3 to 5 parts of sandarac dissolved in 48 parts of ether and 2½ parts of benzol, resembles

ground glass when dry. A solution of dammar resin in benzol mixed with ether also gives a good dull varnish. Water renders the varnish semi-opaque. Alfred Hughes recommends the following receipt:

Ether	560	grammes.
Benzol	240	"
Sandarac	40	"
Canada balsam	10	"

NEW HELIOGRAPHIC METHODS.

By C. Gourdon.—M. Mergel's researches have shown that zinc, on which any metal of the last three groups has been precipitated, is attacked by nitric acid only on the uncovered portions, whilst sulphuric acid, hydrochloric acid, acetic acid, etc., on the contrary, attack only those portions which are covered. Zinc partly covered with a thin layer of precipitated platinum is attacked and dissolved at those parts by sulphuric acid diluted with 7000 times its volume of water. With gold it is attacked by an acid diluted with 500 parts of water; copper requires an acid diluted with 4000 volumes; silver, 3500 volumes; tin, 1500 volumes; antimony, 700 volumes; bismuth, 500 volumes, and lead, 400 volumes. The action is irregular with mercury, the spot gradually enlarging, and the zinc being dissolved only at the edges of the spot. The arsenites, arsenates, and antimonates also give spots which promote the solution of the zinc, but the action is less energetic. Deposits of cobalt, nickel, and iron, on the contrary, are comparable with those of platinum in their action, indeed cobalt causes the solution of the zinc by sulphuric acid diluted with 10,000 times its volume of water.

The author also finds that salts of the same base, but with different acids, yield deposits which do not behave in the same way, the chlorides giving deposits which are more active than those produced by the sulphates, which in their turn excel those of the corresponding nitrates. Moreover, salts rendered slightly alkaline by the addition of ammonia give a more active deposit than the salts themselves; ferrous sulphate, for instance, produces no deposit by itself, but on adding ammonia a very active one is formed. Zinc thus covered with a metallic deposit is also readily attacked by alkalies. The author is of opinion that these phenomena can not be attributed to the action of electricity alone; but that they are partly due to the rugosity of the zinc, produced by the action of the salt.

The reactions above described may be applied to a new kind of heliography.

1. If a photographic picture be laid on a plate of zinc,

the metallic silver by which the picture is produced will be transferred to the plate, forming a metallic deposit, which will facilitate the attack of the zinc by an acidulated liquid. The author has employed potassium cyanide for this purpose, although it presents certain inconveniences. 2. The second process, so far as the necessary preliminary operations are concerned, is founded on the property possessed by certain varnishes employed in the carbon photographic process, of drying up in sunshine, or, again, of remaining dry in the dark and becoming pitchy on exposure to light. The varnishes being applied on the paper, the parts which remain or become moist after exposure to light behind a positive or negative photograph, are alone capable of retaining the active powders, which are applied to the surface by means of a brush.

(4, 32)

MANUFACTURE OF GAS.

MESSRS. WHIPPLE & BLUNT, of Chicago, manufacture water-gas by passing superheated steam through an upright retort containing charcoal or other carbon, and heated by a surrounding furnace, and make oil-gas by passing through a similar retort (heated in the same manner, but filled with pumice-stone) vapor of petroleum or other hydrocarbon. These gases are both discharged into a third retort, where they are thoroughly mingled, and again heated, when they are ready for purification and condensation.

THE "SILBER-LIGHT."

THIS mode of illumination is recommended where gas can not be had. The material used is oil, which is converted into gas before combustion takes place, whereby the combustion of the wick is greatly lessened, (one wick may last a year,) the accumulation of impurity is obviated, and the prevention of smell completely effected. The light is regular and uniform, and of white color. The light with a burner 1¼ inches wide is equal to that of 28 sperm-candles, each consuming 120 grains per hour, and with one 1¾ inches wide a light is obtained equal to that of 50 such candles.

The burning apparatus consists of a row of concentrically inclosed double cylinders perpendicularly arranged at definite intervals. The innermost cylinder contains the wick between its two walls, the hollow space in the interior serving to convey fresh air to the interior of the flame. The second cylinder conveys air to the outer side of the wick, and the third contains oil, and is in direct communication with both wick and reservoir. The mouths of all

these chambers are covered with a dome-shaped head, and from a suitable opening in this the gas streams forth in such a manner that it comes in contact with a current of air, and thus a complete combustion is attained.

According to the nature of the oil burnt, the construction is somewhat varied in its minor details. Rape-oil or light hydrocarbon oils are mentioned. (36)

STEREOTYPES FOR NEWSPAPERS.

A NEW method of supplying newspapers with matter introduced by M. J. Hughes, of New-York, consists in setting in type articles of a miscellaneous character, suitable for the general news and literary departments of country newspapers, stereotyping, by the paper process or otherwise, a number of plates in columnar form, and sending by express to each paper desirous of using such matter, one plate of each article set in type. By this means, the publisher of a paper of small circulation can be supplied with matter at a little above the cost of stereotyping, and can thus give his patrons a much more readable paper than if the type had to be set up especially for his use. The stereotypes are formed of a standard size that will admit of their being used without much adjustment, and are made of different styles; some are cast around a block of wood to lessen the weight of metal, and are made exactly "type high" so as to require no blocking or adjustment, except possibly a "lead" or two, or a "reglet" on each side, should the columns of the paper be wider than the standard size adopted. The latest style proposed is double-faced plates, so that the stereotype may be used in one form for one side of a paper, and then taken out, reversed, and used in the other form for the other side.

IMPROVEMENT IN THE MANUFACTURE OF PAPER.

THE grains and hops after use by brewers are of little value, and can be obtained at a nominal price, and their employment in paper-making is therefore proposed by Messrs. Stehlin, Stehlin & Hahn, of New-York, who state that by first thoroughly soaking the grains and hops, then passing through rollers, which by their crushing action partially separate the fibre, next water-washing on sieves to dissolve and remove the starch, and then macerating in caustic alkali, a fibre will be obtained which only requires bleaching to be ready for making paper either alone or in combination with pulp from other material.

MAKING PRINTERS' TYPE.

IN a machine devised by Julius Silversmith, of Chicago, Ill., types are made from a strip of metal first compressed and properly shaped by rolls, then cut by a circular-saw into proper lengths, on the ends of which the desired letter is formed by a reciprocating matrix, and the nicks on the sides by a trip-hammer or punch.

DRY-PLATE PHOTOGRAPHY WITH GELATINE.

PLACE seven grains of Nelson's gelatine and seven grains of isinglass in cold water for several hours until soft and swollen; then drain off the water, and put them into a two-ounce bottle, which place in hot water until the gelatine and isinglass are dissolved. Add thirteen grains of bromide of potassium, dissolved in a drachm of distilled water; and in another drachm of distilled water dissolve fourteen grammes of nitrate of silver, and add it by degrees, in the dark, shaking well between each addition. Now add half a drachm of a saturated solution of nitrate of baryta, and two drops of muriatic acid. There will be a froth on the top of this emulsion from the shaking, and in order to get rid of this it may be strained through muslin; or, if left in the hot water, it will gradually subside.

This will form sufficient emulsion, at a cost of about twopence, to coat over one dozen quarter plates, which, as coated, should be laid on a flat surface until the film sets, which will take about five or ten minutes, when they can be put away in a box to dry. The drying will take about forty-eight hours, (unless they are placed in a current of dry air,) or they may be exposed at once. An exposure of thirty seconds, with alkaline developer, should give a negative of sufficient printing density without any intensifying. The plates should be placed in cold water for about a minute previous to developing.

Emulsions prepared with the silver in excess caused the plates almost surely to fog, and the image to be very thin and faint. (1)

IMPROVEMENT IN STEEL-PLATE PRINTING.

THE process of steel-plate printing as at present practiced requires the surplus ink to be removed from the plate by a cloth, and that the surface must be subsequently polished by the hand of the printer before every impression, which polishing requires skilled labor to ascertain just when the necessary amount of hand-rubbing has been given to the plate, as the beauty of the impression depends to a considerable extent upon this; because, if rubbed too much, some of the ink will be

removed from the lines. This polishing process is therefore an expensive one, and the rubbing with the hand wears out the fine lines of the engraving very rapidly. To avoid this, J. S. Ives, of New-York, proposes to dispense with the hand-rubbing, by simply washing the plate with a cloth wetted with pure water, after the usual wiping. This, it is stated, will fully accomplish the object sought by the hand-polishing with much less labor and without wearing the fine lines of the engraving. The amount of wet wiping the plate receives is not of much consequence, providing it receives enough to clean the surface, as the wet cloth will only remove the ink from the smooth parts of the plate, and will not affect the ink in the lines. This is supposed to be owing to the polish on the surface of the plate and the slight roughness produced in the grooves made by the graver. As the paper is wet when applied to the plate, the damp condition of the latter is no detriment.

ARTIFICIAL MARBLE.

A GOCD imitation of marble may be made, according to C. F. Barker, of Boston, by mixing calcined gypsum with a solution of alum and copperas in water, afterward drying it by exposure to the atmosphere, next calcining it, then powdering and sifting. The gypsum thus prepared is next mixed with a solution of gum-arabic, salt, and gum-senegal, and moulded into the desired form.

TO COLOR BRASS BLUE LIKE STEEL.

THE brass, laid in a leaden vessel containing hydrochloric and a little arsenic acid, assumes iridescent colors, and may be removed when the desired shade of blue is obtained.

TINNING METALS.

C. PAUL says: Brass, copper, and German silver are tinned by boiling with granulated tin and cream of tartar. Iron must first be cleaned by a mixture of 1 part of sulphuric or nitric acid with 10 parts of water, and then coppered by adding a solution of some copper salt, moistening with a solution of 1 part of protochloride of tin in 2 parts of water and 2 parts muriatic acid, and subsequent immersion in a solution of ammonium copper sulphate. Brass, copper, and German silver, and iron or zinc which have been coated with copper, can be silvered by rubbing with the following mixture: 14 grains of silver are dissolved in 26 grains of nitric acid, and 120 grains of potassium cyanide in 4 cubic inches of water; the solutions are mixed and 24 grains of whiting added.

ELECTRICAL METALLURGY.

SPECIFICATIONS of the English patents of R. Werderman, C.E., have lately been published, which are interesting as presenting a new application of electricity to the arts. This new purpose, to which electricity lends its aid, is to the reduction of metals from their ores, and the refining and purifying of the reduced metals, without the ordinary chemical action of carbonaceous matter, the purifying and refining taking place at the same time and by the same process during the reduction from the ore. The ores, that is to say, oxides, sulphides, carbonates, or other combinations in which the metals exist in nature, are first crushed, and then heated in a suitable furnace or retort. After the whole charge is raised to a red heat, two pieces of carbon or platinum, or some other suitable material which conducts electricity, are plunged in the crushed ore. These two pieces are connected by platinum or other suitable wires or ribbons with the two poles of a galvanic battery or magneto-electric machine. The electrical action and chemical decomposition which then take place may be seen from the following equations, which are given for the purpose of illustration, and are arranged in the order for their elimination:

		Negative pole.	Positive pole.
Oxide of zinc	ZnO	Zn	O
Red oxide of copper	Cu_2O	$2Cu$	O
Plumbic oxide	PbO	Pb	O
Sesquioxide of manganese	Mn_2O_3	$2Mn$	$O+O+O$
Loadstone	$FeOFe_2O_3$	$5Fe$	SO_3, As_2O_5, Ph_2O_5
Hæmatite	Fe_2O_3	$2Fe$	SiO_2, SiO_2, CO_2
Brown hæmatite	$2Fe_2O_33H_2O$	$3Fe$	
Spathic iron	$FeCO_3$	Fe	
Sulphide of zinc (blende)	ZnS	Zn	S
Subsulphide of copper	CuS	Cu, Cu	CuS
Sulphide of nickel	Ni_2S	$2Ni$	SO_3, SO_3
Bisulphide of iron (pyrites)	FeS_2	Fe	$2SO_3$
Manganous carbonate	$MnCO_3$	Mn	CO_2+O
Carbonate of zinc (calamine)	$ZnCO_3$	Zn	CO_2+O

The reduction of iron ores may be effected either in the usual manner in the melting furnace with carbonaceous matter, or in a reverberatory furnace with some suitable flux only. The best ore for this purpose is the hæmatite, because it is a good conductor of electricity. As soon as the oxide begins to flow, the reduction takes place, and all noxious elements are eliminated in the following order, namely, sulphur, arsenicum, phosphorus, titanium, silicon, carbon.

By regulating in a suitable manner the electro-motive

force and the intensity of the electric current, and stopping it at the proper moment, cast-iron, wrought-iron, or steel can be produced directly from the furnace without any intermediate operations. This puddling by means of an electric current will occupy from 10 to 15 minutes only, instead of several hours as in the ordinary puddling by hand labor or machinery, and consequently a great saving of time will be effected.

The entire liberation of the electro-negative elements is in some cases not effected immediately, but an intermediate transformation of the ore takes place. For instance, in treating the subsulphide of copper, this ore does not conduct electricity at the ordinary temperature, but at 230° Fahrenheit it becomes a very good conductor; copper is then produced at the negative electrode or pole, and at the positive pole sulphide of copper is formed, which, being a good conductor at a lower temperature, is now entirely decomposed and converted into metallic copper. A great difficulty in the reduction of plumbic oxide in the usual process consists in the formation of silicate of lead, due to the presence of silicates mixed with the ore. This difficulty is entirely overcome by the application of the electrical current for the formation of the silicate of lead, which is readily fusible and is no obstacle; and all ores rich in silicates, which could not be treated till the present time, can now be employed for the extraction of lead.

Instead of treating the sulphides and carbonates and other more complicated combinations directly by the electrical current, such ores may first be converted into oxides by roasting them in the usual manner for some time in contact with atmospheric air or oxygen. While the metal is being reduced, all impurities and noxious elements mixed or combined with it are eliminated, so that finally the metal is collected perfectly purified and refined.

In purifying metals, the removal of the metals or metalloids which are to be eliminated is effected either in a melting-furnace or in a crucible or converter or puddling-furnace. Two pipes of fire-clay are dipped in the molten metal. Two hollow cylinders of carbon or platinum or other suitable matter are fixed inside the clay pipes at the end immersed in the molten mass. To the carbon or platinum cylinders are attached two platinum wires or ribbons, which run up inside the clay pipes and are connected directly or by means of copper wires to the two poles of a galvanic battery or magneto-electric machine. To prevent the development of heat in the battery or magneto-electric machine, the connecting wires pass through a

cooling apparatus. Instead of hollow cylinders of carbon or platinum, solid cylinders or sheets, or any other suitably shaped pieces, of carbon or platinum or other suitable matter can be used; in the latter cases, space must be left between the said pieces and the fire-clay envelope, to permit the eliminated metals or metalloids to be volatilized and to escape through the clay pipes, and to be collected in a suitable vessel, in which they are converted either into the liquid or solid state or into salts, in bringing them in this *statu nascendi* in contact with any suitable matter to which they have great affinity.

REDUCTION OF COPPER ORES.

THE practical working of the Hunt & Douglas copper process, at the Ore Knob Mine, Ashe County, N. C., is described as follows by J. E. Clayton:

The ore to be treated was a copper pyrites of low grade, dressed to contain from 100 to 120 pounds of copper to the ton of 2000 pounds; the gangue was a clay slate. Our mode of treatment was as follows: The ores were crushed, sized by being passed through a sieve of forty holes to the linear inch, and sent to the calcining furnaces; these furnaces were simple three-hearth reverberatories, and were charged every eight hours with 2000 pounds of the prepared ore; the charges, after being in the furnace for twenty-four hours, were withdrawn, weighed, assayed, and sent to the tanks. The calcination was effected at a low red heat, with a view of converting about one third of the copper in the charge into sulphate; the remainder being as oxides, with the exception of five to seven and a half pounds to the ton remaining as unoxidized sulphuret.

The calcined ore was next charged into tanks of about 3000 gallons capacity, two thirds filled with bath, in weighed portions of 3000 pounds. The mixture was then agitated by a stirring apparatus connected with the tank, and steam injected in sufficient quantity to raise the temperature to about 120° Fahr. After eight hours' stirring, the mixture was allowed to subside, the copper solution drawn off into settling tanks, and about 600 gallons of weak bath drawn down upon the residues remaining in each stirring tank, to cleanse them of the copper liquor. This weak bath was then drawn off into tanks containing metallic iron, the copper precipitated therefrom, and the liquid passed into a reservoir tank, to be again used in washing the residue from the following charge. The stirring tanks were then emptied and the residues wheeled away. The general average of loss in these residues was from six to ten pounds of copper to the ton of ore treated.

The strong copper solution, after fully subsiding in the settling tanks, was drawn into tanks containing iron, (cast or wrought-iron scrap,) the copper precipitated, and the bath, with a small addition of salt, used in the treatment of a new charge of roasted ore.

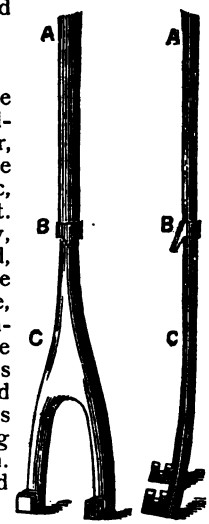
After an experimental trial of a few months, we erected works equal to the treatment of the whole ore-product of the mine. We, in the first start, prepared a given amount of bath, according to the inventors' formula, with copperas and salt; and found in working the process that by calcining the ores at a low heat, avoiding a dead roast, and bringing from 25 to 33 per cent of copper into sulphate, the bath was easily kept at standard strength without the addition of any copperas whatever. The salt added was equal to 25 per cent, and the maximum of iron consumed, to 75 per cent of the copper produced.

Our cost of making copper, obtained as cement, exclusive of mining and dressing the ores, and not including the power required to work the stirring tanks, which was merely nominal, was, for producing 2100 pounds of copper, from 21 tons of 5½ per cent ores, $76.96, equal to 3⅔ cents a pound.

The cost of the plant required is small. The furnaces are simple and inexpensive in construction, and require about 25,000 bricks each. The tanks cost, complete, about $60 each, and the labor employed need not be skilled or high-priced.

THE "JACKSON" DIPPER.

MR. B. PENNINGTON presents to the photo fraternity, through the Philadelphia *Photographer*, a new plate dipper, which is evidently a most useful little affair. He dedicates it to the public, not intending to secure it by patent. The body A he makes out of hickory, covered with shellac. At C it is curved, to keep the plate at a proper distance from the handle. B is a silver slide, which moves up and down on the handle so that any size of plate may be held. One special advantage of this instrument is, that plates may be placed in the bath back up; floating particles of dirt are thus prevented from injuring the film, which leaves the bath clean. Operators who love good work will find this dipper to be of value.



THE MANUFACTURE OF PLASTER-OF-PARIS.

By J. F. Gesner, M.A.—Gypsum is a mineral very widely and abundantly disseminated, whether as the snow-white, translucent, and massive alabaster, the transparent, crystallized selenite, the fibrous, beautiful satin-spar, or the ordinary amorphous, rather soft plaster-stone. It is only when ground and calcined that the term plaster-of-Paris is applied to it, from the great extent of gypsum existing at Montmartre, near Paris, where it has been worked for a long time.

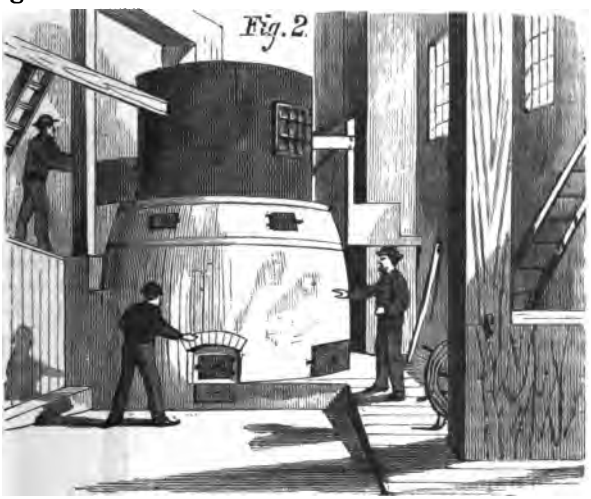


FIG. 1.—CALCINING THE PLASTER.

The many beautiful objects of art into which alabaster is formed, such as vases, monuments in churches, statues, etc., are familiar enough to many. The softness of the stone, and its rapid deterioration when exposed to the weather, render it adapted only for statuettes and other small works of art, or for those which are not intended to be exposed to excessive moisture or climatic influences.

The crystallized and transparent form of gypsum, frequently found in large deposits of the ordinary stone, is known as selenite, from *selene*, the moon, on account of its reflecting a soft moon-like lustre. This variety is capable of splitting up into thin laminæ or leaves, sometimes of large size.

The beautiful satin-spar is a fibrous variety of gypsum,

and exhibits a fine play of light, like lustrous satin. It is used for necklaces, inlaid work, and other ornamental purposes, though it is easily scratched and its beauty destroyed. Anhydrite is the term applied to a hard, compact variety, which is remarkable from the fact of its containing no water; it is consequently inapplicable, as will be seen more clearly presently, for the processes and uses which we are about to describe.

The ordinary amorphous form of gypsum, or plaster-stone, of which we have to treat in this article, is a sulphate of lime, containing, in 100 parts, 46.51 parts sulphuric acid, 32.56 parts of lime, and 20.93 parts of water. It is the peculiar way in which this water is held, its easy expulsion by a moderate heat, and the subsequent readiness of the material to combine with the abstracted water, when again presented to it, and assume the solid state, that give to gypsum its importance in the useful arts, and makes its manufacture on the large scale a great and increasing industry.

In its composition will be noted how substances, highly corrosive in themselves, sometimes unite to form inert and harmless compounds. Confectioners largely adulterate their sugar-plums with very finely ground or elutriated gypsum.

Gypsum, in the ordinary state, as largely quarried, resembles good limestone or carbonate of lime; but it differs from it in not, when pure, effervescing with acids, and in being softer. It is indeed unattacked by acids; but by the action of water it is gradually dissolved and washed away, 1 part requiring 400 parts of water for its solution.

When crude gypsum in any of its forms, except anhydrite, is heated to 212° Fahr., it begins to lose its combined water, and parts with it entirely at 272° Fahr. If it be now withdrawn from the source of heat and, in a powdered condition, mixed with water, it combines with the same quantity previously expelled, and sets or becomes solid as at first. The operation of driving off this combined water is termed calcination.

We come now to the processes connected with the treatment of gypsum for rendering it available for the arts. The principal treatment, on which every thing may be said to depend, is the calcination, or the exposing of the stone to that degree of heat which is just sufficient to expel enough water, so that the powdered material, when mixed with water, will set rapidly into a solid mass. This can be effected in two ways, either by exposing the hard crude stone, in small lumps, to the direct action of flame,

or by submitting the crude powdered material to an indirect source of heat. The first method is practiced in Europe, where the crude gypsum is burnt in kilns, similar to those used for lime, or sometimes in those of more improved construction, but in which the stone is still exposed to a direct fire.

The disadvantages attending this method are that the lower layers of stone are "dead burnt," so that their powder will not set with water, and the upper layers are apt to be insufficiently dehydrated, giving rise to the same evil. Many pieces of gypsum, moreover, when taken from the kiln, are found to contain a core of raw plaster, which of course is incapable of setting solid. After calcination, the stone found to be sufficiently burnt is powdered and packed for use.

The great demand for calcined plaster, and its cheapness for building purposes, have caused large steam-mills to supersede the old-fashioned and slower method of manufacture.

By the kindness of Messrs. Wotherspoon Brothers, proprietors of the Phœnix Plaster-Mills, in West Thirteenth street, New-York City, our artist has been enabled to make drawings which will help to explain the various processes of the manufacture. The crude gypsum which, when brought to the mill, is in masses weighing from 20 to 100 lbs. or over, is broken up by a hammer into pieces rather smaller than an ordinary paving-stone, and thrown by the workman into the crusher. This consists of an upright shaft expanding below into heavy iron cogs, which turn in an exterior iron shell. The stone is here rapidly reduced to powder, but not yet sufficiently fine for the calcining process. A pulley below conducts the powdered material by means of cleats revolving in an inclined wooden pipe, termed a conveyer, to the floor above. This style of conveyer is used in flour mills, and is located on the left side of the crusher. Here the crushed plaster is fed by a hopper, like wheat, to a burr-stone mill, which reduces it to a fine powder, ready for the calcining process. Another conveyer, similar to the one described, carries the fine raw plaster to a bin at the top of the building, where it is delivered in successive charges to the kettles. These, as shown in the illustration, (Fig. 1,) consist of large cast-iron receptacles, capable of holding 45 barrels as a charge. They are set in brick furnaces, and their bottoms are constructed in a peculiar manner and of stout iron, to withstand the heat of an anthracite fire. Revolving stirrers, almost in contact with the bottoms and sides, are kept in motion to prevent caking.

Care and skill are requisite in the calcination process, to avoid either over or under-burning. If all the water be driven off, the plaster will not harden so rapidly as that which has been heated so long as the tumultuous expulsion of vapor lasts; and if only half the contained water be expelled, the plaster will have entirely lost its power of hardening with water. Properly calcined gypsum seems to retain one fourth of its combined water. When the calciner judges the process to be complete, the calcined plaster is drawn out into a bin, where it is conducted to the bolt, which is a revolving cylindrical drum made up of three different finenesses of wire-cloth set on an incline. The

FIG. 2.—THE SETTLING HAMMER.

finest sieve is first encountered, and then the material falls upon the others in turn. Directly below, corresponding to the width of each particular fineness of the sieve, are bins which receive the calcined plaster of three degrees of fineness, known as superfine, casting, and common. From these bins the article is rapidly shoveled into barrels and packed for the trade.

The method of packing is seen in the illustration, Fig. 3. The workman first prepares the barrel by lining its interior by hand with a few sheets of brown paper, wide enough to overlap one another. These project above the top of the barrel, and are folded over in a very secure

manner, thus answering the purpose of a head. Barrels for distant transportation are headed in the ordinary manner.

The barrel to be filled is first fitted with a wide-mouthed funnel, and then placed on a revolving platform, and, while rotating slowly, is tapped rapidly by a hammer actuated by a spring and ratchet wheel. Each shovelful is thus well packed.

This manufactory of the Messrs. Wotherspoon has been in operation over forty years, and utilizes the product of two quarries, one at Wentworth, near Windsor, Nova Scotia, and the other at Hillsboro, New-Brunswick. The establishment is capable of turning out about 2000 barrels per week.

Among the uses of plaster-of-Paris may be noted its employment for a hard finish to walls and the moulding of cornice ornaments, for which purpose, to prevent its too rapid setting, it is usually mixed with a due proportion of slaked lime. A remarkable fact connected with calcined gypsum is, that the addition of two per cent of alum or borax delays its setting three or four hours, but the material then becomes a stone-like body, heavier than ordinary plaster. In Germany, Italy, and England, beautiful cements are made in this way, known as parian. In taking casts and in stereotyping, plaster-of-Paris is largely used.

Besides its use for moulds in potteries, gypsum is employed for glazing porcelain; and, being an excellent non-conductor of heat, for filling fireproof safes. In Spain and France, made into a mortar with sand and quicklime, it is used for cementing floors and vaults.

In the United States, gypsum is extensively used as a fertilizer, and is found to be very efficacious on some soils. It is used as a top-dressing for grasses, and for potatoes and turnips, but the grains do not require it. Liebig has pointed out the fact that it fixes the ammonia of the soil as well as that of the amosphere, thus conveying nitrogen to the roots.

The best gypsum quarries that are worked on this continent are on the Bay of Fundy, Nova Scotia, and Hillsboro, New-Brunswick. Over one hundred thousand tons of the finest quality are annually imported into the United States.

(83)

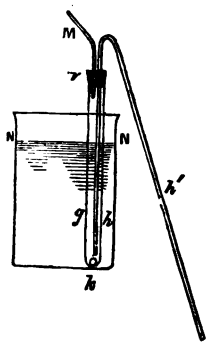
CASE-HARDENING COMPOUND.

A NEW mixture, stated by R. T. King, of Pana, Ill., to be very efficacious for case-hardening iron, consists of sixteen parts of lampblack, eighteen of sal-soda, four of muriate of soda, and one of black oxide of manganese.

A NEW SIPHON.

JOSEPH SEDLACZEK says, in *Poggendorff's Annalen:* It is, in many cases, desirable to withdraw liquid from a vessel by means of the siphon, and a form of the instrument used for certain liquids is that in which the longer arm is furnished with a suction tube, in order that no portion of the liquid may enter the mouth, (though this object is not always attained.) With harmless liquids, a simple bent glass tube may suffice as siphon; but suction with the mouth at the end of the longer arm is somewhat inconvenient.

The following arrangement is simple, but presents certain advantages: A glass tube *g*, .8 inch wide, and 12 or 16 inches long, contracted at the lower end, has at its upper end a cork stopper, in which the mouthpiece M and the siphon *hh'* are fixed airtight. The shorter arm *h* of the siphon reaches nearly to the bottom of the tube, and limits the play of the glass ball, *k*, which acts as a valve. The diameter of the ball is about .4 inch, that of the siphon .2 inch.



The instrument thus arranged, being dipped into the vessel to be discharged, the tubes *g* and *h* become filled with liquid to the surface N N. Instead now of sucking, as with the common siphon, one blows into the mouthpiece M; and in consequence of the compression of air, the lower opening is shut by the ball *k*, while the liquid rises in *h*, and begins to flow through *h'* in the usual way. If the vessel to be emptied is not full, or the column of liquid a small one, it is then necessary, before blowing into the mouthpiece, to suck it slightly, in order to obtain a larger volume of the liquid in *g;* as one condition for the right action of the instrument is that *hh'* should be filled before the column of liquid in *g* sinks to the mouth of the siphon at *k*, when one blows through M.

CLEANSING FLASKS.

IF the flasks have contained resin solutions, they are to be washed with caustic alkaline lyes and finally rinsed with alcohol; if they have contained essential oils, such as oil of turpentine, petroleum, photogene, etc., they are rinsed with one to one and a half ounces of sulphuric acid, and then well washed out in a stream of water.

SIMPLE PROCESS FOR STANNIC CHLORIDE.

BY PROFESSOR BRONNER.—Stannic chloride, as used by the dyers and calico-printers, appears, commercially, in white, crystalline, and more or less solid masses. It is much used in producing scarlet on woolens. It is but seldom pure, containing especially small quantities of iron, and almost always varying quantities of sodium chloride. The iron being positively injurious for scarlets, and not easily removable by the dyers, and the sodium chloride also being objectionable, a simple method is given by which the dyer may prepare his own stannic chloride. Pure stannous chloride is taken, which should not give a blue precipitate with potassium ferrocyanide, or white with barium chloride, and this is treated in a porcelain dish with its own weight of pure fuming hydrochloric acid, and then with four times its weight of boiling water. By addition of potassium chlorate in small successive portions to the hot solution, with gentle stirring, the stannous chloride is easily converted into stannic chloride without liberation of chlorine gas. For 1 pound of pure and quite dry stannous chloride, 90 grammes of potassium chlorate, at the most, are required. The addition of chlorate is discontinued when the solution, at first clear, turns yellow and begins to liberate chlorine. (36)

IMPROVEMENT IN DENTISTRY.

THE usual method of destroying decayed or broken teeth practiced by dentists is to build upon the base of the old tooth a new one, by condensing gold with a hammer until it has assumed the desired form. This process is both tedious and costly, and J. B. Beers, of San Francisco, therefore proposes to substitute for this "built-up" crown a hollow crown of gold lined with enamel, and secured to the base by a gold screw, which is first set in the tooth and the hollow crown attached to it by filling the cavity with any of the dental cements, and placing the crown over the screw in the exact position it is intended to occupy. The enamel secures a good grinding surface.

PARCHMENT SIZE.

THIS consists of gutta-percha softened and extended in ether. It furnishes a preservative coating for pictures, cards, etc. Any extraneous matter is easily removed from it by means of a damp cloth. Easily effaceable charcoal and chalk drawings are fixed, if this solution be distributed over their surface in fine spray. The ether evaporates and leaves the gutta-percha, which forms an extremely thin, but protective coating over the design.

POSTAL-CARDS.

H. M. JOHNSTON, of New-York, proposes to manufacture paper and board designed especially for postal-cards, by enameling ordinary paper or board with a compound of glue and Kremnitz white, (and coloring matter if desired,) then calendering and treating with a mixture of eleven ounces of sulphate of aluminum, eight ounces of chloride of sodium, four ounces of biborate of soda, eight ounces of chloride of ammonium, and two gallons of water. Any mark or writing made by a metallic pencil on paper or card-board so prepared will, by the chemical action between these, compound, and the deposit from the pencil become indelible.

SEWING-MACHINES.

A NEW style of sewing-machine designed by Onésime St. Amant, of Quebec, has the foot so arranged that it can feed the cloth by its movement in any desired direction. This machine is provided with a series of levers acting on the foot, and these levers are controlled by cams on a pattern wheel, so that, by varying the cams on said wheel, any desired series of motions in different directions may be given to the foot, and the line of stitching varied accordingly, so as to produce automatically a variety of fancy designs in ornamental stitching. Each machine may have a series of pattern cam-wheels, which may be readily changed to produce the desired figure.

NEW METHOD OF TREATING HORN.

A METHOD of treating horn practiced by William Birch, of Walworth, England, by which it is converted into a substance resembling whalebone, consists in first cutting the horn into strips, then softening and pressing flat, and next boiling in a closed boiler in a decoction of sage-leaves to which has been added a little potash. Horn so treated can be rolled into long strips by passing through rollers, and the ends of the strips can be joined together by the pressure of the rolls; or, large sheets may be made by joining the strips at the sides, the rolling firmly uniting the edges so as to form one piece.

TREATING SEWAGE.

IT is stated by Baldwin Latham, of London, that by treating sewage with sesquisulphate or sulphate of aluminum, in conjunction with lime or chalk, a precipitate is obtained which, when partially dried and allowed to stand until cabalytic action takes place, produces humus that, after carbonization with sulphuric or similar acid, can be used for deodorizing other sewage.

NEW HOT-AIR ENGINE.

IN a new style of caloric engine designed by N. A. Otto, of Gasmotoren-Fabrik Deutz, at Deutz, Germany, hot air or gas at atmospheric pressure is drawn into the cylinder during about two thirds of the down-stroke of the piston, when the supply is cut off and the air or gas expanded during the remainder of the stroke. The first part of this down-stroke is made very rapidly, so that the air or gases have not time to cool, but during the latter part, and at the time the engine is passing over the centre, the air and gases are cooled by the heat being absorbed by the surface of the cylinder kept cool by a water jacket. By this means, the pressure in the cylinder is considerably less than that of the atmosphere without, and as the cylinder is open at one end, the pressure of the atmosphere causes the piston to return to its original position, thus giving motion to the main shaft and fly-wheel, and the momentum of the latter drawing in the hot air for the next stroke.

TEMPERING BY MEANS OF SEALING-WAX.

THE steel used by watch and clock-makers and engravers is hardened in sealing-wax. The *Journal of the Franklin Institute* says that the steel is made white hot, and is thrust into sealing-wax, allowed to remain a second, then withdrawn, and again inserted in another part; this treatment being continued until the steel is so cold that it will no longer enter the wax. "The hardness thus attained is extreme, and is comparable to that of the diamond; in fact, steel hardened by other processes may be engraved or bored with it, the engraving or boring tool being previously moistened with oil of turpentine."

IMPROVEMENT IN VENETIAN BLINDS.

A NOVEL application of colored and ground glass, instead of wood or iron laths, for Venetian window-blinds, is worthy of notice. The glass strips are bound round with brass, to preserve their edges; and heavy blinds are simply wound up and down with something like a clock-key. The play of colors may thus be managed so as to give beautiful effects; outside by night and inside by day, windows with these blinds affixed will look as if they were illuminated. These blinds, we need hardly say, are expensive, compared with those now generally used; but where cost is not a matter of chief consideration, they are likely to be appreciated.

THE color developed in certain kinds of glass containing manganese upon exposure to sunlight, is regarded by J. Henrivaux as due to oxidation.

CASTING IRON IN METALLIC MOULDS.

JOHN WILLIAMS, of Philadelphia, states that by coating metallic moulds with a thin coating of red lead (minium) mixed with oil or water to the consistency of cream, iron may be cast in moulds so coated without the usual blowing or escaping of gas and vapor, which usually leaves the casting defective or defaced by wavy surfaces, air-holes, or other blemishes.

ARTIFICIAL IVORY.

Two pounds of pure india-rubber are dissolved in thirty-two pounds of chloroform and the solution saturated with purified ammoniacal gas. The chloroform is then evaporated or distilled off at a temperature of 185° Fahr. The residue is mixed with pulverized phosphate of lime or carbonate of zinc, pressed into moulds, and cooled. When the phosphate of lime is used, the resulting compound partakes in a great degree of the nature and composition of genuine ivory, for we have the requisite proportion of the phosphate, and the india-rubber, which takes the place of the cartilage; and the other component parts of the genuine article are of little importance.

UTILIZATION OF SOAPSTONE CLIPPINGS FOR BUTTONS, ETC.

THE powder or other filings of soapstone (steatite) obtained in the manufacture of gas-burners is saturated with soluble glass, dried, and ground. In a suitable press, buttons and similar articles are pressed from this powder, burned in retorts, dipped again in solution of glass, and once more burned. They are then placed in a rotating cask, polished by water, dried, and again polished by rotation in a similar cask with soapstone powder. Dominoes and dice are pressed in similar manner, in dies of brass or steel, and then polished.

SUBSTITUTE FOR FLOOR OILCLOTH.

A NEW fabric intended to be used for floor-cloth, etc., proposed by J. L. Kendall, of Foxboro, Mass., consists in mixing finely-cut sponge with one fourth its weight of paper pulp, then running the mixture into sheets on a paper-machine, saturating with linseed-oil, and subjecting to pressure between rolls to remove the superfluous oil.

DIAMOND STONE-SAWING MACHINE.

HERBERT COTTRELL, of Newark, N. J., has designed a machine for sawing stone, in which an endless band is used having attached to it sections of steel armed with diamond points for cutting the stone.

IODATE OF CALCIUM AS A DISINFECTANT.

By E. Sonstadt.—I have continued to make experiments on the properties of iodate of calcium as an antiseptic and disinfecting agent; the experiments have been made with the dry salt, and also with a solution of the salt made by dissolving 1 grm. of the iodate in 1 litre of water. The principal putrescible substances experimented upon have been urine, albumen, fish, meat, and rain-water.

The experiments on urine were begun in the spring of 1872. Equal quantities of fresh urine were put into two test-tubes, and to one portion a small pinch of the solid iodate was added: the specimens were placed close together. After a few days, the specimen to which nothing had been added became very offensive, and I added to it about a fourth of its volume of the solution containing 1 part of iodate to 1000 parts of water. The next day the offensive odor was gone, but still enough odor remained to make the nature of the fluid recognizable. The specimen to which the solid iodate had been added at no time took any offensive odor, and after several weeks could not even be recognized for what it was by the smell. The minute quantity of solid iodate that had been added to it remained apparently undissolved; up to the present time, (December, 1873,) no sensible odor has been given off by this specimen. I have repeated this experiment several times with like result.

PRESERVATION OF EGGS.

The experiment on albumen was begun on July 30, 1872. Two fresh eggs were taken, and the whites put into two similar bottles. ½ decigrm. of iodate of calcium was added to, and shaken up with, the white in one of the bottles, the white in the other bottle being left as it came from the egg, for the sake of comparison. The two bottles were kept side by side, sometimes corked, sometimes uncorked, but were always treated exactly alike. The white of egg to which the iodate had been added remained sweet for about six months, after which it began to get discolored, and to smell disagreeably. It is now of a dirty yellow color, and has a whitish deposit. The other specimen, containing no iodate, smelt disgustingly after about a fortnight, and is at present of a brown color with brown deposit. The odor is perhaps now equally strong from both specimens, but there is as great difference between the quality of the odors as in the appearance of the specimens.

Eggs, immersed in the iodate of calcium solution, were after a month not to be distinguished by smell or taste

from perfectly fresh eggs; how much longer than a month they may be thus preserved, experience only can determine.

PRESERVATION OF FISH.

The experiments on fish have been chiefly made on herrings. Freshly-caught herrings immersed in iodate water (containing 0.1 per cent of iodate) remain in hot weather perfectly good for about four days, after which they begin to slowly change. If dry iodate is sprinkled over the fish, (1 or 2 decigrms. of iodate to a dozen fish,) instead of immersing them in the solution, the result is the same, and in neither case is it possible to detect the slightest foreign flavor in the taste of the fish. It is remarkable that the solid, and very sparingly soluble, iodate of calcium, which, so sparsely sprinkled over the fish, can only be in contact with very small spots here and there, should still exercise its preservative power throughout as completely as when a solution is used; that such is the case has, however, been proved, not by one or two experiments, but by many, since both last season and this, I have very frequently eaten fish kept fresh for a few days after being caught, by the dry or wet method indifferently. Salt herrings, a staple article of food in the Isle of Man in the winter-time, have more or less of a disagreeable rancid flavor, whether eaten with or without removal of the salt they have taken up. But if salt herrings are first soaked in water long enough to remove as much of the salt as is considered desirable, and then immersed in iodate-water for twenty-four hours, they lose entirely this disagreeable flavor, and are completely restored to the condition as to flavor that they were in when freshly caught.

PRESERVATION OF MEAT.

I have made several experiments on the preservation of meat by the iodate, and have obtained results similar to those described for fish. In the case of meat, the solution of the iodate can not advantageously be used, since the juices are extracted, and the meat thereby injured. A very minute proportion of the solid iodate sprinkled over meat will keep it good for three or four days (in summer-time) longer than it will otherwise keep, and if the meat has acquired a taint before the application, the taint is completely removed; this applies to the cooked as well as to raw meat. In one case, I sprinkled over a small joint of beef which, after cooking, proved to be tainted to the bone, and in every part, about a decigrm. of the iodate. The iodate was simply dropped from between the finger and thumb over—and, of course, only very partially over

—the surface of the meat; yet the next day the meat was as good as it was possible for meat to be, and was eaten with much relish. How the nearly insoluble iodate can have produced such an effect over parts that it could not come near to, I do not understand; I only vouch for the fact.

IMPROVEMENT OF RAIN-WATER.

Putrid rain-water becomes odorless and agreeable to drink twenty-four hours after the addition to it of one fourth its volume of the 0.1 per cent iodate-water. A litre of unfiltered rain-water to which 1 centigrm. of the iodate (1-100,000th) was added on the 10th of January, and kept in a bottle, is still, to all the senses, as it was on the day the specimen was taken.

PRESERVATION OF BUTTER.

Fresh butter covered with the iodate solution loses nothing in quality during three weeks, and would probably have kept good much longer. Butter that has begun to get rancid is greatly improved by soaking for a day or two in the solution, especially if once or twice worked up in it. Salt butter, after the salt has been washed out, and steeped in the solution for a day or two, is, if originally of good quality, made nearly equal to fresh.

EFFECTS UPON FOOD AND HEALTH.

Such small quantities of iodate of calcium as may be introduced into food by the treatment described do not in any way alter the normal taste of the food; the only modification produced is to restore the original flavor when that has been disguised or impaired by commencing decompositions.

In order to ascertain if much larger doses than any that could under any circumstances be introduced into the food eaten at a meal could produce any injurious effect, I took at various times different doses of the iodate, the largest dose taken being 1 grm. This dose left a slight after-taste in the mouth, but I perceived no inconvenience, except a slight headache next day, an increased appetite, and, generally, such effects as might follow taking an ordinary dose of quinine. Some of my friends have tried small doses, such as a decigrm. at a time, in some cases with no sensible effect, in others with marked increase of appetite and increase of vigor. But it is in cases of fever and of attack by diseases such as typhus and cholera, propagated by some specific organic poison, that I should expect the exhibition of iodate of calcium to be followed by marked effects. A layman has small opportunity of making ex-

periments in such directions. On one occasion, however, after exposure for some time to foul, putrid odors, I found myself attacked by the usual premonitory symptoms of a typhoid fever, and all these symptoms *entirely* disappeared within a few hours after taking about a decigrm. of the iodate: one of my friends can give similar testimony. It appears to me that the iodate acts simply as a tonic on persons in health, but that, when there is an organic virus in the system, it is a potent agent in destroying such virus and in purifying the system. As a minor application, I may mention that the iodate has given speedy relief in cases of toothache arising from caries.

I have made some experiments on the iodates of sodium, potassium, and of magnesium, in reference to any power they might have as antiseptics or disinfectants, but find them, although not quite without effect, very feeble as compared with iodate of calcium. (2)

PHOTOGRAPHY IN NATURAL COLORS.

HELICHROMY, as hitherto practiced, is based on a fact first noticed by the late Sir John Herschel, that ordinary sensitive chloride of silver paper which had been exposed to the light until it had become of a deep blue color—until, in short, it had been subchlorized—was then in a condition in which, if reëxposed to light under strongly-colored media, the various colors of the media were reproduced upon the paper. But to attempt to obtain colors upon subchlorized paper without the addition of an oxidizing agent will lead to much disappointment, and to M. Poitevin must be ascribed all the credit of rendering the heliochromic process one of certainty. By washing a sheet of subchlorized paper with a solution composed of equal parts of saturated solution of bichromate of potash, saturated solution of sulphate of copper, solution of chloride of potassium, (twenty grains to the ounce,) and allowing it to become dry, colored impressions were obtained with certainty. M. De St. Florent modifies this formula in one or two respects. For example, he immerses the subchlorized paper in a weak solution of nitrate of mercury, which of itself causes the paper to be in a proper condition to receive colored impressions; but he prefers adding the nitrate of mercury to a solution which will, by comparison with that of M. Poitevin, be seen to differ from it in no important respect, being composed of—

Sat. sol. bichromate of potash (or ammonia)..	2 parts.
Sulphuric acid.....	2 "
Chlorate of potash.....	1 part.

The great sensitiveness obtained by M. De St. Florent

is probably owing to his exposing the paper while it is moist, instead of allowing it to become quite dry, as did M. Poitevin; and it is possible that by adopting the suggestion of Mr. R. J. Fowler, our former Paris correspondent, of forming the subchloride in a film of collodion, and exposing this while wet, a degree of sensitiveness may be obtained as far in advance of that which has already been reached as the sensitiveness of an iodized wet collodion film surpasses in sensitiveness the same film after it has been dried. (1)

NEW DRY PLATE PRESERVATIVE.

H. J. NEWTON, of New-York, finds that the sensitiveness of photo-dry plates is greatly increased as follows:

I mixed some mustard-seed with tea for a preservative for dry plates, and I found it increased the sensitiveness very much. I took two table-spoonfuls of mustard-seed and two table-spoonfuls of Japanese tea, and poured on eight or ten ounces of boiling water, covered it over, and let it stand and steep for one or two hours. I then added ten grains to the ounce of sugar of milk, and filtered through cotton; made up to ten ounces, and added two ounces of alcohol. It was then ready for use. I found that the plates would give the same detail in a minute and a quarter that with the tea alone would take five or six minutes.

I found also by crushing the mustard-seed in a mortar before it was steeped with the tea, it made a much more sensitive plate than in putting the seeds in whole; but they did not keep as well, and were nearly worthless in two weeks. With the seeds whole, it required about two and a half minutes, and the other way about ½ minute and a quarter exposure, while, in general, I give five minutes exposure to tea.

WOOD-ENGRAVING PHOTOGRAPHS.

THE following formula will be found useful to wood-engravers, or to those who are photographing on wood. To prepare the block for the sensitive coating, make a thin solution of gelatine, six grains to the ounce of water, mixed with some gilders' white; coat the surface of the block with this, using a wide camel's-hair brush; when dry, brush over the prepared surface in the dark-room some of the following solution:

First. Red prussiate of potash.....120 grs.
Water..... 2 ozs.
Second. Ammonia-citrate of iron.....140 grs.
Water..... 2 ozs.

When dissolved, mix together and filter. This solution

should be kept in the dark. When the coating has dried, expose under a negative in sunshine for ten or twelve minutes, then take the block where the light is not very strong, and wash the surface lightly with a soft sponge in water, and a beautiful dark-blue picture will appear, that will not chip in cutting.

To make a red picture, prepare as above, but use the following mixture; dissolve twenty or thirty grains of sulphate of uranium in one ounce of thin gum-arabic or gelatine-water; brush this on the block or canvas in the dark-room; when dry, expose under a negative for ten or twenty minutes in sunshine; then wash well with a sponge and water; now take a clean sponge charged with a solution of red prussiate of potash, twenty grains to the ounce of water, and apply it quickly all over the surface, and the picture will appear immediately. When all details are out, wash clean with a fresh sponge and water. A drop or two of muriatic acid in some water will bleach the picture if over-printed. (13)

PYROTECHNIC SIGNALS.

ALEXANDER LAMARRE, of Paris, states that by boiling or evaporating linseed-oil until reduced one half in bulk, so as to form a kind of glue, and then adding to it any of the usual signal compositions, at the rate of one part of the linseed-oil glue to eight parts of the latter, the compound so produced will not only be cheaper, but will burn brighter and be much less liable to spontaneous combustion, or to explosion from a blow, or damage from damp.

GLASS PRESS.

THE presses at present in use for pressing glassware are all operated by manual power. This has heretofore been considered necessary because when the proper amount of pressure had been produced, it was injurious to go beyond that point, and as the amount of glass in the mould constantly varied, the degree of pressure varied with it. This variation of pressure has therefore prevented the use of steam-power in glass presses; but J. Haley, of Pittsburg, states that this difficulty may be overcome by the introduction of a spring between the plunger and the crank on the driving-shaft, which will yield when the necessary pressure has been given.

MANUFACTURING GLASSWARE.

A NEW method of manufacturing glassware, designed by J. S. & T. B. Atterbury, of Pittsburg, Pa., consists in pressing the upper part of an article—a pitcher, for example—in a mould having a movable bottom, so as to form the

lip-rim, handle, etc., and then after lowering said movable bottom, forcing a current of air through the plunger, to expand the glass at the bottom of said plunger into a lower chamber of the mould so as to form the globular or lower part of the pitcher. By this method of operating, a variety of articles may be readily and cheaply produced, that could not be well obtained either by pressing or blowing singly.

CEMENT FOR AQUARIA.

A RECTANGULAR tank of about ten gallons capacity, and constructed of plate-glass with a zinc bottom and massive wooden pillars, troubled me for a long time by leaking. It was cemented with red and white lead, covered with a coating of shellac varnish, and was constantly being recemented in the faulty places; but after the lapse of three weeks or so, it would leak afresh. Some time after, a friend recommended a cement composed of resin, tar, and linseed-oil, which I tried, and am pleased to relate that the said aquarium has now been standing just a year with the water unchanged, and shows no signs of leakage whatever. I used about an eggcupful of oil and 4 oz. of tar to 1 lb. of resin, and allowed them to melt together over a gentle fire. If much oil be used, the cement will in all probability run down the angles of the aquarium; to obviate this, it should be tested before use by allowing a small quantity to cool under cold water, and if not found sufficiently firm, allowed to simmer longer, or have more tar and resin added, which will answer the same purpose. The cement should be poured in the angles of the aquarium while in a liquid state, but not when boiling, or it would most assuredly crack the glass. The cement will become firm in a few minutes, and the aquarium may then be tilted up in a different position while a second angle is treated likewise; and so on till the whole work is completed. This combination of tar and resin adheres firmly to the glass, is so pliant that it may be pressed into any shape with the finger, and it does not communicate any poisonous quality to the water. (16)

PLASTIC CARBON FOR FILTERS.—Professor V. Kletzinsky recommends two mixtures, the one composed of 60 parts coke, 20 parts animal charcoal, 10 parts wood-charcoal, and 10 parts pipeclay; the other is composed of 10 parts coke, 30 parts animal charcoal, 20 parts wood-charcoal, and 40 parts short asbestos. The ingredients, except the last, are pulverized, sifted, and mixed dry in proper proportions, then kneaded with an equal weight of molasses to a plastic mass, baked in a muffle, soaked in dilute muriatic acid, washed, dried, and baked again.

BUTTER REFINING APPARATUS.

BUTTER is very readily rendered unmarketable by improper handling. If it is worked too much, it becomes tough and greasy; if too little, the milk contained causes it to turn sour, bitter, and often rancid. It may even be spoiled by a too long exposure to the air. When in such condition, about the only remedy is, melt the butter and clean the same while in a liquid state; but the result of this process is to cause a sandy, unpleasant consistency to the taste, which, although the butter may be perfectly sweet, renders it unmerchantable. This effect, however, Mr.

BUTTER REFINING APPARATUS.

George W. Kerchhoffer, of Chicago, Ill., thinks may be prevented by suddenly cooling or congealing the melted butter, to which end he has recently devised the apparatus illustrated herewith. A quantity of the material in a melted state is placed in a reservoir A, its temperature being kept between 100° and 120° Fahr. B is the congealer, which is filled with milk or buttermilk, and through the hollow sides of which a current of cold water is maintained so that the temperature of the milk is retained between 55° and 65° Fahr. Pressure is next applied to the surface of the melted butter in the reservoir through the pipe C, and a

valve being opened forces the butter down through the tube D, and out of the perforated nozzle at its end into the cold milk. The congealed particles rise to the surface of the liquid, and after being skimmed therefrom are thrown into a filter E, through which the milk escapes, and thence runs on the inclined trough below back into the congealer. When sufficiently drained, the butter is taken from the filter and handled in the ordinary way—that is, worked, salted, and packed just the same as if freshly made from the cream.

MANUFACTURE OF STEEL.

C. M. NES, of York, Pa., states that by melting together equal parts of ordinary hæmatite and Codorus, silicious, magnetic ores in a blast-furnace, the compound may be run into pigs, which, by decarbonization, will become steel. Or the ordinary ore may be melted, and from fifteen to twenty per cent of pulverized Codorus ore stirred in. The pigs so formed may be used to make steel, or it may be mixed with pig-iron. By melting the Codorus ore with ordinary ore in this manner, the impurities of the former are eliminated, thereby saving the cost of transporting said impurities when the ore has to be taken to distant places to be used in the manufacture of steel.

CONDENSING MILK.

IN the usual process of condensing milk, sugar has to be mixed with it, if to be kept for a long time; but Messrs. Gail & John G. Borden state that, by first heating the milk in a closed vessel above 212° Fahr. so as to destroy any germs of fermentation, and then condensing it in a vacuo in the usual way, the addition of sugar may be dispensed with.

PRODUCING TURPENTINE FROM SAWDUST.

S. L. COLE, of Brooklyn, N. Y., states that turpentine may be economically manufactured by loading sawdust in metallic cars which are run into a steam-tight chamber, and the sawdust subjected to steam of a high temperature, which will cause the turpentine to collect in the bottom of the chamber.

ENDLESS BELTS.

LEEDHAM BINNS, of Oakenshaw, England, proposes to make endless belts or ropes for driving machinery, etc., by winding sufficient material in the form of a skein, then properly securing the ends, and next covering said core with other strands, either by winding, weaving, or braiding. If preferred, a covering of caoutchouc may be added and the whole vulcanized.

(192) JOHN W. DRAPER. (SEE BIOGRAPHY.)

ELECTRICITY, LIGHT, HEAT, SOUND.

THE ELECTRICAL CONDENSER.

IN the working of the steam-engine, the office of the condenser is to assist the power and economy of the machine, by rapidly removing the back pressure of the exhaust-steam and converting it into water for re-use in the boiler. In a somewhat analogous manner, the employment of the electrical condenser appears to facilitate and improve the working of certain kinds of telegraphs. When a battery current is sent through an insulated telegraph wire, there is produced another current, termed static induction, which interferes with the operation of the battery current.

On the ordinary pole telegraph with the ordinary instruments, the static induction gives little trouble; but in the case of subterranean and submarine cables, the induced currents prevent the rapid working of the instruments.

The electrical condenser consists of tin-foil, separated by sheets of insulating material, such as paraffine paper; and when the metal of the condenser is connected with the telegraph wire, it absorbs the electricity of induction, and changes it so that it acts to assist instead of retard the transmission of telegraphic signals by the instruments.

The various submarine cables could hardly be worked with commercial success, were it not for the combination with them of the condenser. The condenser has been recently applied to some of the land-lines with greatly improved results. It is employed in connection with the Stearns duplex instruments, by which messages are simultaneously transmitted in both directions over one wire; thus doubling the capacity of transmission without augmenting the expenses. This invention has lately been adopted by the British government.

Another recent application of the electrical condenser is in connection with what is termed automatic telegraphy. This consists in operating the sending key by drawing under it a strip of perforated paper, each perforation, of given length, representing a given signal. At the opposite end of the line the message is received upon chemically-colored paper, the color of which is instantly changed and the signals made visible by the passage through it of the electrical currents. The great trouble with the prac-

tical working of this system of telegraphy always has been that the static electricity operated to string out the electrical waves, producing tailings, making the signals to run into or overlap each other, and render them illegible, upon the receiving paper. This was especially the case if a certain limit of rapidity in the transmission was exceeded. This limit of transmission was 100 words per minute over a line of 250 miles extent; which is about the speed of the common Morse instrument.

Mr. George Little, who is well known for his indefatigable efforts and ingenuity in connection with automatic telegraphy, has applied the condenser to his instruments with marvelous results. He states that it enables him to transmit 5000 words, or 30,000 signals per minute, over one wire with perfect legibility, and that the instruments of the Automatic Telegraph Company are now working the system at this rate between New-York, Philadelphia, Baltimore, Washington, Mobile, and other cities.

This discovery promises to be of much importance in the business of electrical transmission. It will enable people to do their correspondence in full by telegraph, instead of by brief sentences, as at present. It will assist to prevent blunders in transmission, for which at present there is no remedy, except by double payment. It is well known that the Western Union Company will not otherwise guarantee the correct delivery of any messages sent over their lines. The successful introduction of the automatic system will, however, put an end to this extortion. The facility of transmission is so great that the Automatic Telegraph Company is now enabled to send twice as many words, for the same money, as the other lines; and thus the sender may make sure of a correct delivery of his message, without loss of time or payment of extra charges.

Another striking advantage of the electrical condenser is its use in connection with subterranean wires. It permits the transmission of signals with as much facility when the wires are placed underground as on the pole lines, and will enable our city authorities to pass ordinances requiring the removal of the many poles which now disfigure and encumber our streets. (83)

TELEGRAPHIC SAFETY-BOAT.

IT has been proposed by Mr. John Newlands, in consequence of the sudden destruction of the two large ocean steamships, the Atlantic and City of Washington, that each large passenger-ship should carry a small but powerful steamboat or launch, so that in foggy weather this launch could be sent on ahead some few hundred yards, being

connected with the passenger-ship by a flexible telegraphic cable provided with an electric battery, by means of which signals or messages might be continually transmitted from one to the other. The steam launch should also carry an electric or other strong light, and be provided with a powerful steam-whistle. On meeting with ice or with vessels, or unexpectedly approaching the coast, it would be comparatively easy to stop the steam launch, and give warning in time to save the steamer from danger. (39)

ELECTRICAL FIRE-ARMS.

PROFESSOR SAMUEL GARDNER, Jr., the man who lights the Capitol at Washington by electricity, has invented a method of discharging fire-arms which dispenses with gun-locks and all that sort of machinery. Within the handle of the pistol or gun he has a galvanic battery, or a Leyden bottle and a rubber to produce electricity. Thence a wire extends to the cartridge, the arrangement being such that on pressing a pin with the finger, a spark of electricity enters the cartridge and fires the powder. Now, if the professor will only make one more improvement, namely, shoot the ball by electricity without gun or powder, he will distance all competition, and add new laurels to his already distinguished fame as an electrician.

CARRE'S ELECTRICAL MACHINE.

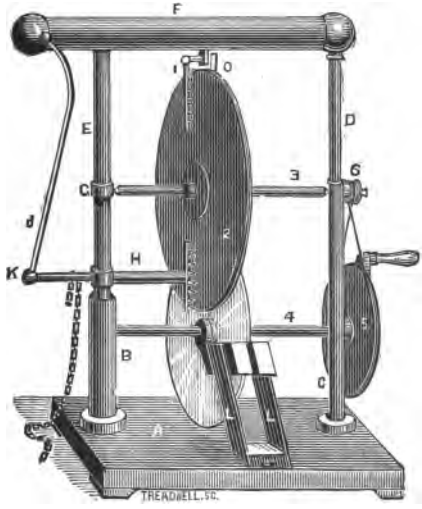
THIS machine consists of an arrangement by which a current of electricity is derived from a combination similar to the electrophorus.

A is the base of wood or metal, 1½ inches thick and 16 inches square. B and C are two round pillars of wood, (or ebonite,) B being 10 inches and C 17 inches long; they are both 2 inches in diameter. The pillars pass through the base, and have nuts below to fix them securely. E is a round ebonite (or glass) rod, 1¼ inches in diameter and 16 inches long + the piece of it screwed into B. The rod D is of glass or ebonite, 8 inches long, and the same diameter as the other, with a piece 1 inch long at the lower end fitted with cement into C, and a piece 2½ inches long at the upper end going up into the prime conductor F. The conductor is a cylinder of tin plate lackered black, with two brass spherical ends fitted into it, one of which has a pipe soldered into it, up which the end of the glass rod D goes and fits tight. The rod E has a hole, tapped with a screw-thread in the upper end, and a screw is put down from inside the conductor into this, and secures the conductor to the rod.

1 and 2 are disks of ebonite—1 being 12 inches, and 2

being 18 inches in diameter. They are fixed to the axes 4 and 3 respectively. 4 is turned by the pulley-wheel and handle 5, and this pulley-wheel drives 2 at a rate six times as fast as 4 goes round. The rate of the upper disk may be more than this, but should not be less. The lower disk is $\frac{1}{8}$ inch thick, the upper one a full $\frac{1}{16}$. The axes are of wood, with brass fittings at the ends.

The band in the figure is represented as crossed, but it is no matter which way 2 turns. At G is a collar of brass, with a pinching screw to hold it on the rod E, and this collar carries the pin at the end of the axle 3, on which it



CARRE'S ELECTRICAL MACHINE.

turns. H is a brass pipe carried by a similar collar, and carrying the comb for collecting the electricity as near as possible to the surface of 2; at the other end is a bell K, capable of rotating stiffly on its axis, carrying the brass wire J, with a ball at the top, which can be thus made to touch the conductor or be fixed at any distance from it. At I is a comb attached to the conductor; and on the other side at O a piece of ebonite, about $2\frac{1}{2}$ inches long and 1 inch wide, is attached to the conductor parallel with the disk 2, and having on the side next the disk a piece of varnished paper cemented to it with four or five points cut on the edge of the paper, which is somewhat wider on one side than the ebonite plate, so that these points

are projecting in the direction in which the disk 2 is turning. A correspondent says that he put this apparatus to his instrument as a matter of faith: it seems to work as well without it, and he does not in the least understand what its office is. Lastly, at L L is the rubber, consisting of two cushions, which clasp the disk 1 closely, and are supported by two thin wooden springs L L, fastened to a block of wood at the bottom, which slides on and off on a dovetail fixed to the base A. The cushions are covered with thin leather, stuffed with horse-hair; and the amalgam is bisulphuret of tin, called *aurum musivum*, rubbed on the cushions. The disks overlap by 4 inches, and run as close together as possible. The disks should be carefully selected, without winding or buckles in them. When the machine is in action, the comb at H is connected with the ground by a chain, and the ball at the top of J is brought away from the conductor till the striking distance is attained. This machine gives from ·3 to 5-inch sparks easily and in torrents, with a condenser showing a square foot of surface. One or two of the sparks are enough for most people. There is a necessity for occasionally washing the disks, first with fluid magnesia and then with paraffine, as the ozone appears to turn the sulphur of the ebonite into a coating of sulphuric acid, which attracts moisture. This would be avoided by glass disks, but they produce much more friction. A piece of Bristol-board well dried, and when well dry well coated with shellac, might be tried for the disk 2. If glass rods are used for E and D, they should be coated with shellac, as the machine is much inclined to blow and leak everywhere. (40)

THE OPEISCOPE.

THIS is a new and simple instrument, suggested by Professor A. E. Dolbear, for the purpose of demonstrating the pulsations of sound. Take a tube of any material, from one to two inches in diameter, and anywhere from two inches to a foot or more in length. Over one end paste a piece of tissue paper or a thin piece of rubber or gold-beater's skin; either will do. In the centre of the membrane, with a drop of mucilage fasten a bit of looking-glass not more than an eighth of an inch square, with the reflecting side outward, of course. When dry, take it to the sunshine, and, with the open end of the tube at the mouth, hold the other end so that the beam of reflected light will fall upon the white wall or a sheet of paper held in the hand. Now speak, or sing, or toot in it. The regular movement of the beam of light with the persistence of vision presents very beautiful and regular patterns, that differ for each different pitch and intensity, but are quite

(192) JOHN W. DRAPER. (SEE BIOGRAPHY.)

6. That the aurora spectrum is probably a mixed one, and that the red and yellow green lines are independent spectra; as also may possibly be the corona line and the continuous spectrum crossed with the fainter lines.

7. That the discrepancies in the observations recorded are considerable, and that all the lines, (except, perhaps, Angstrōm's,) and specially the red one, require further examination to confirm their positions.

A NEW THERMO-ELECTRIC BATTERY.

WHEN a bar of bismuth is soldered to one of antimony in the form of a ⋖ and the point of junction warmed, an electric current is set up, which may be increased by augmenting the pairs of the combined metals.

A new form of this battery, recently invented by Mure and Clamond, consists of 60 pairs, made of iron and lead, and the electro-motive power is equal to two Bunsen elements. By the use of 39 gallons of gas, about 2 drams of copper were precipitated in an hour, the surface of the electrodes being 11 square inches, and their separation from one another 0.4 inch. The cost of depositing 2¾ lbs. of copper by this battery, in Paris, where gas is sold at 3 cents per 35 cubic feet, would be $2.36.

The largest battery which has been as yet constructed upon this plan consists of 150 large pairs, and has an intensity equivalent to 5 Bunsen cells of medium size. A battery of 560 small pairs arranged for tension have an intensity equal to 60 Daniell cells. In both cases, the gas consumed is about 210 gallons per hour.

NEW ELECTRICAL INSTRUMENT.

AMONG the recent patents granted here is one to F. H. Varley, of London, England, for a novel portable electrical machine. It consists of a glass or rubber rod, having upon it an exciting band or girdle of suitable cloth. A small Leyden-jar is attached to the girdle. The rod is held in one hand and the girdle moved with the other. The friction of the girdle upon the rod excites electricity which passes to the jar, and thus a considerable quantity of electricity may be collected. It is a simple and apparently an effective instrument.

DYNAMICAL THEORIES OF HEAT.

PROFESSOR W. A. NORTON publishes in the *American Journal of Science and Art* a lengthy treatise on the above topic, more especially in answer to the query: Is heat any mode of motion of the atoms of ordinary matter: such atoms being regarded, in accordance with the common notion of an atom, as incapable of experiencing any change either of form and dimensions or in the intensity

of their acting forces? The conclusions arrived at are, that the atoms of bodies must be made up of distinct parts, bound together by certain forces; and that heat must consist in some movement or relative displacement among these constituent parts of the atoms. Two possible conceptions of an atom with its essential accompaniments are given: That it consists of a true atom, surrounded solely by an atmosphere of luminiferous ether, or that it has, in addition, an envelope of distinct electric ether immersed in the ethereal atmosphere. In view of these results, it is considered probable that heat and light originate in some mode of motion occurring in the ethereal atmosphere or in the electric envelopes of the atoms, or, more probably, in the force or forces by which such a movement is produced.

Simplified, Professor Norton's theory, though at first conveying the negative idea of a complex atom, transfers the source of heat from the atom proper to a supposed ethereal atmosphere or electric envelope, one or both, and therefore, following the hypothesis, to a form of matter considered to be nearly, if not quite, as subtle as the medium of light, and whose elastic forces are nearly or quite as intense.

FLAMES FROM COMPRESSED GAS.

M. F. BENEVIDES, Professor of Physics at the Industrial Institute of Lisbon, commmunicates to *Les Mondes* a note of his investigations upon the above subject. He states that combustible gases, compressed and burnt in the air, cause some interesting phenomena, which may be readily observed. Among others it may be noted that, when the gas is under great pressure and consequently escapes from the apparatus in large quantities under a high velocity, its flame proper does not begin at the orifice of exit, but at some distance above it. There merely appears at the apertures a slight glow, which is separated by a large obscure space from the luminous jet. The dimensions of this interval depend upon the pressure, rapidity of exit, and quality of gas, while its temperature is quite low. This M. Benevides considers due to the mechanical action of the current of gas, which forces the air back to a certain distance and thereby cuts off the supply of oxygen necessary for combustion. Above the obscure space, the gas, having dilated, mixes with the air, and a luminous jet of high temperature is produced. On increasing the flow of gas, air becomes drawn in with it, and the brilliancy of the flame disappears, though the temperature is greatly augmented. Finally, when the aperture is small and the ve-

locity great, the air is crowded away, and ignition will not take place.

In cities in which localities varying greatly in level receive gas for illuminating purposes from the same gas-meter, at points above the source of supply, effects analogous to those above described may be produced. The reason is, that, other circumstances being equal, the rapidity of the escape of the gas is greater in elevated situations, because this velocity depends on the difference between the pressure of gas and that of the atmosphere, and the atmospheric pressure becomes less in proportion as the altitude of the point of observation increases. In cities, therefore, like Lisbon, and we may add Boston or Albany, at situations near the level, it often happens that the supply of gas fails during the day, while at more elevated spots there is always a sufficiency. It follows, then, that in order to have the same brilliancy of light, burners and conduit-pipes being the same, the opening of the valve regulating the supply must be greater for the low localities than for those on eminences. In positions high above the sea-level, if the supply-valve be widely opened, the rapidity of escape of the gas becomes very great, and air is drawn in with it; and, consequently, the effect of the Bunsen burner is produced, as before noted.

ACTION OF ELECTRICITY ON FLAMES, LIQUIDS, AND POWDER.

By Neyreneuf.—The flame of pure hydrogen is attracted by the negative pole. With the carbon monoxide flame, attraction takes place when both poles at once are presented to it. This result is considered important since the flame contains no solid particles, and no water is formed. Carbon sulphide behaves in the same way. Alcohol acts like coal-gas. The flame of oil of turpentine burnt in a lamp is very much repelled by the current.

If either pole be perpendicularly directed close to the surface of water, oil, carbon sulphide, or oil of turpentine, contained in a good conductor, the liquid rises in a small cone, which subsides directly the surface is touched by the pole. Even with liquids which are bad conductors, a similar cone is produced, if the pole be first dipped into the liquid and then slowly withdrawn.

Several substances, when in powder, exhibit phenomena similar to the above. When either pole is brought within a certain distance (not stated) of some of the blue drying-sand used on the continent, there is at first a centrifugal effect, and then, on a nearer approach, a centripetal, owing to the well-known action of the "electric wind." When

the sand is touched by the pole and the latter is cautiously withdrawn, a cone of sand is formed.

All these movements of flames, liquids, and powders, except those caused by the "electric wind," are considered to be due to a current of air which flows from the positive to the negative pole. (4)

ELECTRICAL IGNITION BY BELTS.

AT Cleveland, O., a hard-wood plug had been put into a hole in a gas-pipe that ran along the ceiling of the *Leader* printing-office, several feet from any burner, and in a position where no one could ever suppose it would catch fire. About six inches below it, passed a belt running from one pulley to another, and in operation during the day. About four days after the plug had been driven into the pipe, it was noticed to be on fire, and a bright jet of light, as if from a burner, burst forth from the side of the plug, which was already charred and being rapidly burned up. How the plug caught fire, how a steady flame of light could suddenly burst out from the side of it, was of course a subject of anxious inquiry. No one had lighted it and no fire had been used near it. The only conclusion possible was that it was caused by electricity from the belt, and a full investigation confirmed this conclusion. Had it happened in the night-time, it might have enkindled an extensive conflagration, and its origin would never have been known. Many destructive fires may have started in this manner, their causes remaining forever unknown.

HAMMERING IRON TO MAKE IT RED-HOT.

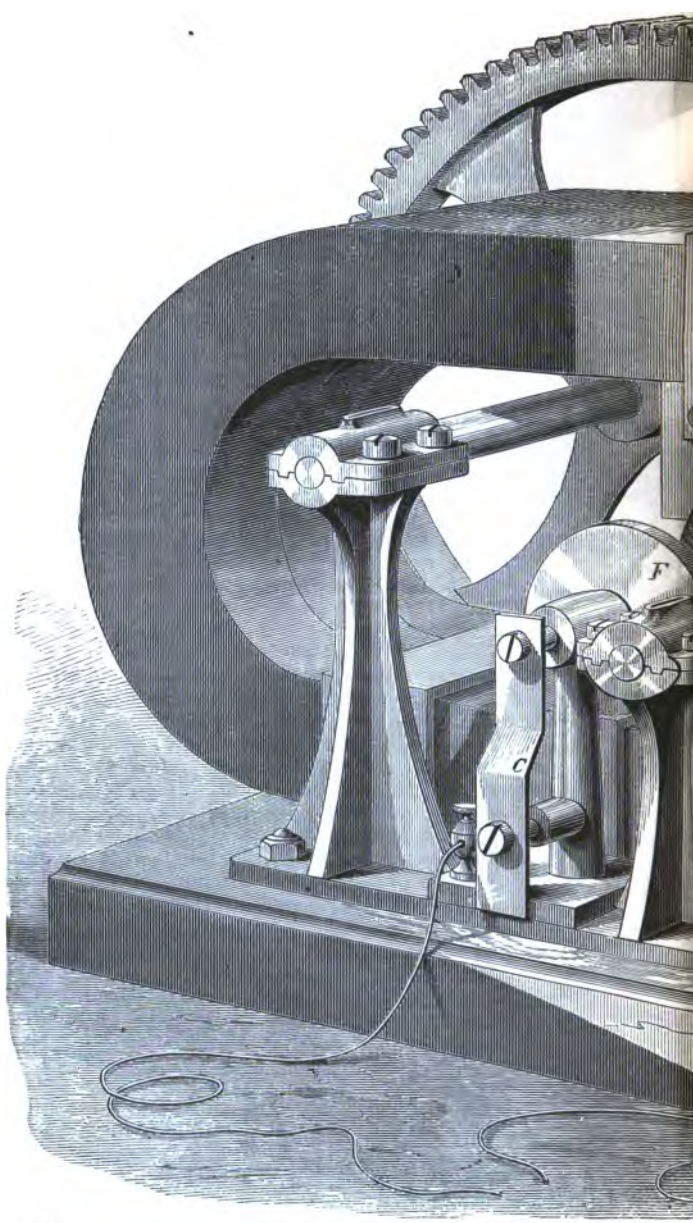
ROBERT BOYLE alludes to the rapid development of heat in an iron nail by repeated blows of the hammer *after it had ceased to travel* into the wood. It has been asked whether iron could be hammered cold until it became red-hot. Mr. Rodwell informs us that it can. Having requested a blacksmith to try the experiment, a piece of very tough iron was hammered with a moderately heavy hammer; it became hot, but would not scorch a piece of paper. It was then hammered by two men, one of whom used a sledge-hammer, but with no better result. Presently a man who was working in the shop said he had often lit his forge-fire by this means, before matches were plentiful. He took a nail such as is used for horse-shoes, and after hammering for less than two minutes with a light hammer, part of the nail was brought to a light red heat. The blows were light but frequent, and the nail was partly turned at each blow. This is an easier way to produce fire than the old plan of rubbing sticks together. (99)

RECENT PROGRESS IN ELECTRO-MAGNETISM.

MUCH ingenuity has been wasted upon the problem of converting electricity into mechanical force; or, in other words, of constructing electro-magnetic engines destined to drive machinery, to raise weights, or to draw loads. Hundreds of such engines have been made, only to demonstrate the conclusion of scientific men, who have long ago given up the problem as incapable of a practical solution. It is not difficult, indeed, to show by a very simple calculation that, in the present state of science, the electro-magnetic machine can never compete with the steam-engine, because of its far greater cost. The force in the former is derived from the oxidation of zinc in the battery, while that of the latter is due to the oxidation of the carbon in the coal burned under the boiler. Now, 1 gramme of carbon burned will raise the temperature of 8080 grammes of water 1° centigrade, while 1 gramme of zinc will only raise 1300 grammes to the same extent. Thus carbon would seem to be 6.2 times as effective as zinc. After the oxidation of the zinc in the battery, the solution of the oxide in the sulphuric acid produces an additional quantity of force (or heat) capable of raising 335 grammes more, which must be added to the 1300 grammes; from this, however, must be deducted the force wasted in decomposing the water in the battery, a force capable of raising 1060 grammes of water 1° centigrade. The balance, 575, is 14 times less than the effective force of coal, and yet even this comparatively small amount of force is only attainable in the theoretically perfect battery. Taking into account that coal is about 40 times cheaper than zinc, the odds are 40 times 14, or 560 to 1, against the electro-magnetic machine.

While thus any effort to convert electricity into the grosser form of mechanical force must fail, until zinc can be manufactured about 600 times more cheaply than coal can be mined (which it probably never will be) or until some other source of electricity be discovered, physicists have been eminently successful in reversing the problem: that is to say, converting mechanical force into electricity, and they have utilized the electricity so obtained in the production of the most intense artificial light known. Before describing the immense improvements made very recently in this department of science, it may be well to study the apparatus hitherto employed.

When a piece of soft iron surrounded by insulated copper wire is presented to the poles of a magnet, a momentary electrical current is formed in the wire; and on removing the soft iron from the magnet, another current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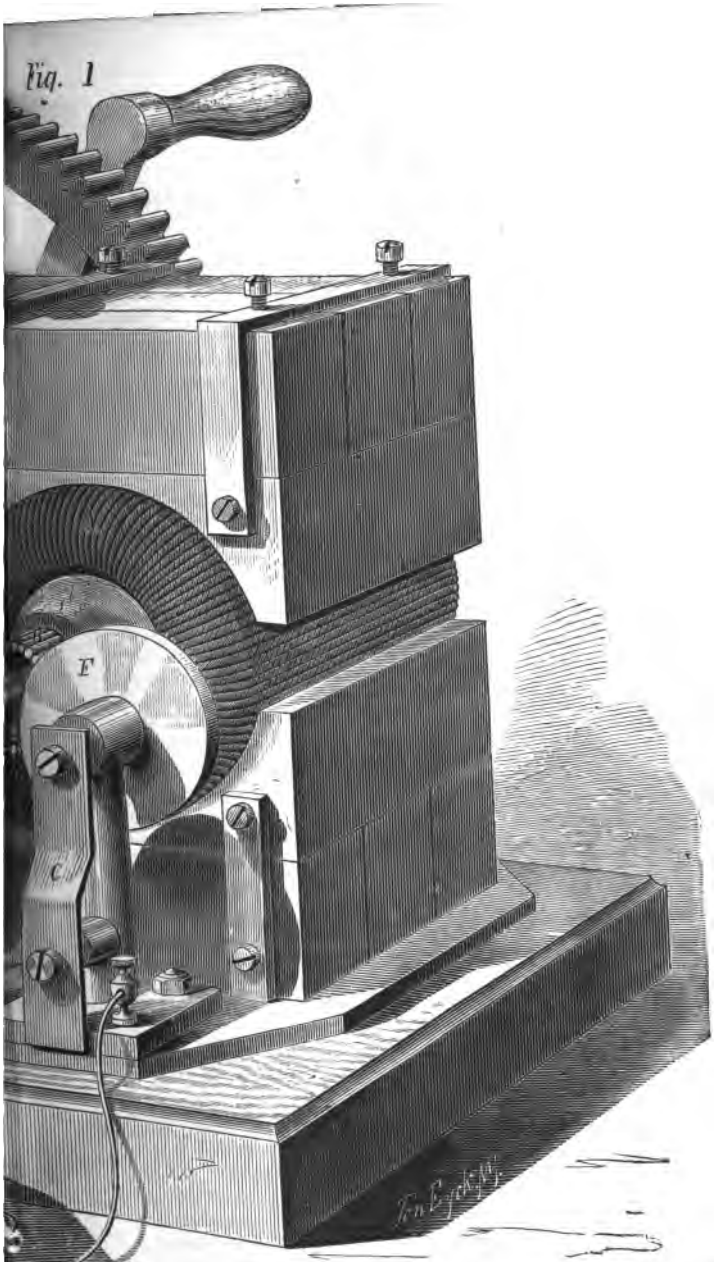


RIC-LIGHT MACHINE.

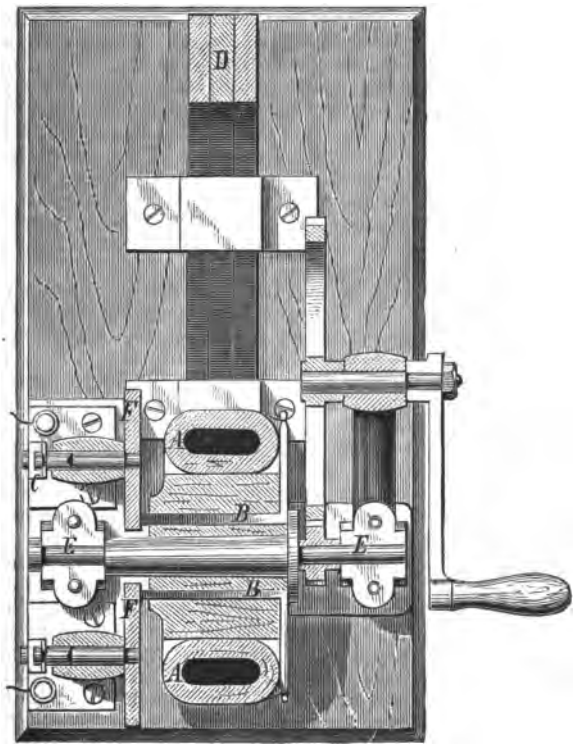
is formed in the opposite direction. Now, these currents may be made to succeed each other with extreme rapidity by revolving the insulated iron bar before the poles of the magnet, and they may also be made to flow in one direction. The former may be done by steam, and the latter is accomplished by a device called a commutator. Thus a powerful current is produced, capable of showing all the phenomena of the battery in an exalted degree. Machines constructed on these principles have been extensively used to produce the electric light and in electro-plating.

The Wilde machine is in operation in this city for plating purposes, at Frank Leslie's printing establishment. The machine runs with a velocity of 1800 revolutions a minute, and will electrotype a number of plates as large as the illustrated newspaper in 20 minutes. Wires are also connected with the machine, which lead to the photographic establishment across the street, and on cloudy days they print photographs by means of the electric light produced by the Wilde machine.

The results obtained by these machines and by subsequent modifications certainly leave little to be desired; but the machines themselves, unfortunately, have inherent defects. The currents produced are intermittent; at each revolution, two electrical pulses proceed in one, and two in another, direction. To collect these, a friction commutator is necessary, which wears away very fast. In Holme's original machine, it only lasted from 10 to 20 minutes; and in the latter machines, in which over 1890 revolutions per minute are obtained, there must necessarily be considerable wear and tear whenever there is a metallic contact of moving parts.

These difficulties have been overcome in a machine invented by M. Gramme, of Paris, and recently exhibited before the French Academy of Sciences by M. Jamin. Our engravings illustrate the invention. The principle is as follows: If the north pole of a permanent bar magnet be moved along a soft iron bar surrounded by an insulated wire, it will produce a south pole in the iron bar, which will gradually be displaced from one end of it to the other, following the motion of the bar magnet. The result is a continuous induced current in the surrounding wire. If, now, the soft iron bar be made into a ring A, and placed between the poles of a horse-shoe magnet D, these poles will of course induce currents in opposite directions, neutralizing each other at two points of the ring, midway between the poles, exactly (according to Mr. Crookes) as if we had two batteries connec ed in opposition by joining their similar poles. On revolving the iron ring on the

journals E, a continuous current is developed, as in the case of a straight bar, but in opposite directions, because here we have to do with both poles of the exciting magnet. Both these currents will continually neutralize each other at the two mean points. To utilize them, all that is necessary is to connect conducting wires to the insulated



GRAMME'S NEW ELECTRIC-LIGHT MACHINE.

wire at the mean points, and they will flow along these wires instead of neutralizing each other; just as in the two batteries above, connecting a disk F with each point of contact of the similar poles, will cause the force of the batteries to flow through the conducting wires "quantity-wise." M. Gramme accomplishes this in the following manner:

If the wire wound upon the ring is very thick and there is but a single layer of it, it is sufficient to remove the insulating covering at some point which, in its revolution, is made to touch fixed metallic conductors F, situated at the neutral points. If, however, many layers of fine wire are used, the following device is adopted: The wire is divided into sections of, say, 300 turns each, there being no break, however, in the wire on passing from one section to another. Each section has its wire exposed at one point, and to this point is soldered a solid bar of brass B, capable of considerable wear and tear. The bars thus attached to the sections are arranged radially; and when the ring, A, is revolved, several of them simultaneously touch two solid metallic rubbers F, at the neutral points. More than one bar is made to touch at a time to prevent any break in the current.

The machine exhibited before the French Academy of Sciences derived its magnetism from an electro-magnet instead of a permanent one. It was provided with four metallic rubbers, two of which supplied the electro-magnet with a part of the current generated. The machine started with the feeble residual magnetism in the electro-magnet, which rapidly gained in strength as the velocity increased. A machine of this kind, having 15.4 lbs. of copper wire 0.118 inch thick, decomposes water and fuses 1.04 inches of iron wire 0.036 inch thick when worked by hand. A large machine, driven by a 2½ horse-power engine, which was exhibited in London, produced a light equal to about 8000 candles; and still larger machines are being made, which Mr. Crookes expects to give a light equal to 25,000 candles. Besides the purposes of illumination, such machines, of the smaller sizes, will be of service in telegraphing, electro-plating, gilding, medicine, military operations, and chemical decompositions. They are of especial value in electro-plating, on account of the constancy of the current. In the galvanoplastic works of M. Christofle, of Paris, it is found that the best machine hitherto known, when moved with a velocity of 2400 revolutions per minute, only deposits 5.465 ounces troy of silver per hour, while a smaller Gramme machine deposits 9.645 ounces troy of silver per hour with one eighth the velocity. It would be difficult indeed to foresee what further increase in power may yet be obtained in these machines; for investigators are constantly studying the properties of magnets and the means of augmenting their strength.

M. Ruhmkorff, to whom science already owes so much, still continues his experiments in electricity and magne-

tism. He has presented the following facts to the French Academy of Sciences:

If a bundle of iron wires, covered with thick copper wire giving passage to an intermittent current from a battery, is then wrapped with fine wire for the purpose of obtaining an induced current, that current will have more than double the usual intensity if we wrap the fine wire around the middle of the bundle, where there is no magnetization, instead of wrapping it near one of the poles. He concluded from these premises that he could get still more powerful effects by making a continuous ring of his iron wires, which would then present no poles; but in this he was disappointed, for the induced current gave a spark only 0.1 inch long. On cutting the ring, the spark at once increased to 0.2 inch, although the cut ends came together the moment they became magnetic.

On keeping the ends apart with a plug of wood 0.2 inch in thickness, the spark reached the length of 0.6 inch. With thicker plugs of wood, no further change was produced. It still remains to be seen what practical application can be made of this fact.

Jamin, in studying the magnetism of thin steel plates, found, by magnetizing plates of various dimensions and superposing a number of similarly magnetized ones, that he could construct magnets carrying twenty times their own weight. The thinner the superposed magnetized plates, the more powerful the resulting magnet. His researches will probably reveal the law according to which magnets, having a minimum weight and a maximum carrying force, may be constructed. See engraving elsewhere.

It seems, too, as if we were rapidly approaching the solution of the problem of an electrical illumination for our streets and houses. The difficulties hitherto have been: that it is impossible to regulate the intense brilliancy of the electric light, which would be blinding on the street, and of course utterly unfit for lighting our houses; that it is not continuous, but requires the frequent renewal and adjustment of the carbon points, involving expense and complicated apparatus for each lantern; and finally that a separate source of electricity is required for each lamp. All these difficulties are said to have been obviated by the invention of Mr. A. Ladiguin, of St. Petersburg, which was recently exhibited by Kosloff & Co., the proprietors of his patent, in the Admiralty House of that city. We give a description on another page. It will, we understand, be soon introduced in this country, and promises to be of much utility. (83)

NEW PLAN FOR OBTAINING A POWERFUL LIGHT.

HERR EDELMANN, of Munich, has devised a very simple and satisfactory mode of obtaining a powerful light, well suited for photographic purposes, if the materials employed be judiciously selected. He has found that the oxyhydrogen flame produced from common coal-gas and oxygen at ordinary pressure produces an intense light, of any desired color, if, by means of it, we burn a mixture of picrate of ammonia with a suitable metallic salt.

To this end, a hollow cone of hard gas carbon—similar to that used in electric lamps—is prepared of the following dimensions: Height, 1¾ inches; diameter, 1 inch, tapering to ⅜ of an inch, and pierced by a tube tapering in the same direction from ⅛ to ¼ of an inch. This conical carbon tube is placed, narrow end down, upon an upright oxyhydrogen jet, the compound nozzle of which fits into the narrow end of the inverted cone of carbon. The oxyhydrogen jet is the usual kind of double tube, the coal-gas issuing round the oxygen nozzle; and when the gases are ignited, they burn through the centre of the cone, which then resembles a small carbon furnace 1½ inches in depth.

The number of these cones to be made corresponds with the number of intensely bright colored flames required. When the gases burn in the ordinary way, scarcely any light results; but in order to produce the desired effects, we spread over the inner surface of a cone, with a spatula, paste made by rubbing together in a mortar picrate of ammonia, the metallic salt desired, and alcohol. The cones are then allowed to dry at ordinary temperature, and placed over the double tube when light is required. To produce the flame, the oxygen tube, which should be movable in a vertical direction, is raised as high as possible, the coal-gas lighted, and the oxygen then turned on. By moving the oxygen tube slowly downward, and regulating the gas supplies, the point at which the greatest brilliancy is produced can be readily ascertained. The light obtained is very intense and steady while it lasts.

If a white light be desired, sulphide of antimony or magnesium filings can be mixed with the picrate of ammonia; but if it be desired to use the light for showing on the screen metallic spectra, the chlorides of sodium yellow, thallium green, iridium blue, and calcium are most suitable; while Herr Edelmann finds that the chlorate or nitrates of strontium red, barium pale green, and copper deep green, afford the most satisfactory results. For photographic purposes, the antimony would be most suitable,

but it should be mixed with the picrate of ammonia with caution.

This plan of obtaining a powerful metallic light is specially recommended for illustrating some of the phenomena of spectrum analysis. At present it is usual to employ the electric light for the purpose of projecting spectra on a screen in order to exhibit them to a large audience. The cost and inconvenience of the electric light is, however, so great as to debar many from trying to exhibit these beautiful experiments. Edelmann now proposes the above plan for producing intensely brilliant metallic flames as a substitute for electric method, and states that he has succeeded perfectly in projecting the spectra on a considerable scale when using the very simple and inexpensive source of light above described. (1)

THE ELECTRIC LIGHT.

UP to the present time, as is well known, the electric light has been used only for light-houses, as an electric sun illumination for signals, or on the stage, where a strong light may be required without regard to cost; but thus far it has been quite impossible to employ it for lighting streets or houses. By the old method, the electric spark was passed between two points of charcoal, each attached to a copper wire connected with an electro-magnetic machine. The disadvantages attending this mode consisted in the facts that for each light a separate machine was required, and that the light so obtained, although very powerful, was impossible to be regulated, besides being non-continuous, owing to the rapid consumption of the charcoal points from exposure to the air. All these difficulties Mr. A. Ladiguin, of St. Petersburg, Russia, has tried, and apparently overcome most successfully. By his newly-invented method, only one piece of charcoal or other bad conductor is required, which, being attached to a wire connected with an electro-magnetic machine, is placed in a glass tube, from which the air is exhausted, and replaced by a gas which will not at a high temperature combine chemically with the charcoal. This tube is then hermetically sealed, and the machine being set in motion by means of a small steam-engine, the charcoal becomes gradually and equally heated, and emits a soft, steady, and continuous light, which, by a most simple contrivance, can be strengthened or weakened at the option of those employing it, its duration being dependent solely on the electric current, which of course will last as long as the machine is kept in motion. Taking into consideration the fact that one machine, worked by a small three horse-power engine, is ca-

pable of lighting many hundreds of lanterns, it is evident that an enormous advantage and profit could be gained by the illumination of streets, private houses, public buildings, and mines, with the new electric light. In the latter it must prove invaluable, as no explosion need ever be feared from it, and these lanterns will burn as well under water as in a room. Without mentioning the many advantages this mode of illumination has over gas, which by its unpleasant odor and evaporation is slowly poisoning thousands of human beings, and from which explosions are frequent, we can state that, by calculations made, this electric light can be produced at a fifth of the cost of coal-gas. (72)

A NEW METHOD OF MEASURING THE VELOCITY OF LIGHT,

SUGGESTED by Professor Dolbear, consists in observing one of the planets, as Venus, both when approaching and receding from the earth, with the spectroscope. Two lines on opposite ends of the spectrum are measured with regard to their displacement, both in approach and recession. If the lines of red and violet rays move with the same velocity, the displacements would be the same. When they move with varying velocities, the difference gives an approximating measure of the light's velocity.

LIGHT FROM ELECTRICAL TUBES.

DR. GEISSLER, of Bonn, Germany, whose name is inseparably associated with some of the most beautiful experiments that can be performed by the agency of electricity, makes an electrical vacuum tube that may be lighted without either induction coil or frictional machine. It consists of a tube an inch or so in diameter, filled with air as dry as can be obtained, and hermetically sealed after the introduction of a smaller exhausted tube. If this outward tube be rubbed with a piece of flannel, or any of the furs generally used in exciting the electrophorus, the inner tube will be illumined with flashes of mellow light. The light is faint at first, but gradually becomes brighter and softer. It is momentary in duration; but if the tube be rapidly frictioned, an optical delusion will render it continuous. If the operator have at his disposal a piece of vulcanite, previously excited, he may, after educing signs of electrical excitement within the tube, entirely dispense with the use of his flannel or fur. This will be found to minister very much to his personal ease and comfort. He may continue the experiments, and with enhanced effect, by moving the sheet of vulcanite rapidly up and down at a slight distance from the tube. This beautiful phenomenon is an effect of induction.

EFFECT OF LIGHT ON SELENIUM.

SELENIUM is a substance that resembles and is allied to sulphur. It is found in connection with some natural deposits of sulphur, but it more commonly occurs in combination with metals, forming selenides. Selenium is less combustible than sulphur, burns with a blue flame, and emits a putrid horse-radish odor.

Mr. Willoughby Smith has been making a series of electrical experiments with selenium, and, at a recent meeting of the Society of Telegraph Engineers, London, he made known the following remarkable results:

The sticks of selenium were connected with platinum wire, and hermetically sealed in glass tubes. The electrical resistance of some of the sticks was very great, others much less, and he was at a loss to account for this lack of constancy, until, after various trials, he found that it was due to the action of light. When the sticks of selenium were shut up in a box so as to exclude light, the electrical resistance was highest and remained constant; but when the cover was withdrawn and light was allowed to fall on the sticks, the electrical resistance diminished 15 to 100 per cent, according to the intensity of the light. The shading of the selenium by means of glass plates of different colors showed that the conductivity was altered in proportion to the interception of the light. These are very singular observations, and may lead to new and useful discoveries concerning the qualities of other substances, and the manner in which light and electricity affect them.

LENS FIRES.

DR. H. C. BOLTON, of Columbia College, New-York City, states that on a recent occasion, at 9 A.M., on entering his laboratory, he found a wooden table on fire, ignition having been occasioned by the rays of the morning sun, which fell upon a glass spherical flask containing water. The flask served as a lens, which concentrated the rays and set fire to the wood. The author also alludes to the statement of Lactantius (A.D. 300) who mentions the use of glass globes, filled with water, to be used in kindling fires; while Pliny recommends the use of lenses for the purpose of cauterizing the flesh of sick persons. As to the latter, one Mr. Barnes, of Connecticut, took a patent in this country some five years ago for the use of lenses for the purpose suggested by Pliny.

In respect to fires occasioned by lenses, doubtless there are many examples. It is well known that vessels at sea have been set on fire by the bull's-eye glasses used to admit light to between decks. These glasses were formerly made

convex on one side, thus forming powerful lenses. In consequence of the loss of property and danger, their use has been discontinued, and thick plates of glass, flat on both sides, have been generally substituted.

Captain Scoresby and Dr. Kane used to astonish the natives of the polar regions by taking blocks of clear ice and cutting them into the form of lenses, with which they instantly kindled fires.

NEW RELATION BETWEEN HEAT AND ELECTRICITY

MR. FREDERICK GUTHRIE, in the *Chemical News*, states that it is found that the reaction between an electrified body and a neighboring neutral one, whereby the electricity in the neutral body is inductively decomposed and attraction produced, undergoes a modification when the neutral body is considerably heated. Under many circumstances, the electrified body is rapidly and completely discharged, a fact proved to depend upon the temperature of the discharging body and its distance from the electrified one and the nature (+ or —) of the latter's electricity. The discharging power of a hot body diminishes with its distance and increases with its temperature. It also depends on the quality and not the quantity of heat radiated from it to the electrified body. It is necessary for the discharge that heat of intensity pass to the electrified body from a neutral body within inductive range.

It is shown that various flames, both earth-connected and isolated, have an exceedingly great power of discharging both kinds of electricity. As hot iron shows a preferential power of discharging — over + electricity, so it is found that white hot but isolated iron refuses to be charged with either + or — electricity. As the iron cools, it acquires first the power of receiving — and afterwards of receiving +. While white-hot iron, in contact with an electrified body, prevents that body from retaining a charge of either kind of electricity, as it cools, it permits a + charge to be received and subsequently a — one.

A suggestion is made as to the existence of an artificial coercitive force, the presence of which, together with its diminution by heat, would explain much of the above.

EFFECTS OF MAGNETISM ON IRON.

DURING the last session of the National Academy of Science, at Cambridge, Mass., Professor Mayer gave some interesting information regarding the effect of magnetism on iron. He states that he has discovered, by means of the Saxton comparator, that rods of iron suffered a perma-

nent elongation by magnetization of one hundred and fifty millionths of an inch. English refined iron gave the maximum of elongation, scrap-iron the minimum. Whether the current was gradually increased in intensity, or whether it was sent full charge at once, it produced the same degree of elongation. With one cell, the elongation took place in six tenths of a second; with 25 cells, it took place in two tenths of a second. Professor Pierce thought if the elongation of iron under magnetization were true, it might make its effect on the earth in an appreciable difference in the length of the day. This could be detected by astronomy. A change in the day of seven hundredths of a second would be perfectly easy to discover now.

AN ELECTRICAL TOWER.

MR. WILLIAM H. WARD, of Auburn, N. Y., has suggested an electrical tower for accumulating natural electricity for telegraphic purposes. The structure, which is to be placed on high mountain peaks or other elevated stations, is to be made in three sections. The lower portion is a mere shell containing a door. Above this, and insulated from it by a diaphragm is the middle part, in which are openings or windows having slats pivoted in them, so that, by means of raising or lowering rods suitably connected to such shutters, the openings may be shut or opened. A projecting roof extends over the windows, serving to protect them from the weather and also for receiving the aerial electricity which may be drawn from it by wires for land-line purposes. Above this roof is another insulating diaphragm. The highest portion of the tower is surmounted by a bent ventilating tube and vane, so arranged and connected with the rods acting upon the shutters that the revolution of the vane by the wind will open the windward and close the leeward slats. The wind therefore assists in driving an aerial current of electricity into the insulated middle portion of the tower, which current passes upwardly through the upper portion of the tower and out through the ventilator, thus forming a draught by means of which the electrical current is forced out at the vane. Insulated wires leading from the top portion of the tower allow a supply of electricity to be drawn therefrom.

By the use of the aerial electricity which surrounds the earth in the upper strata of the atmosphere, the inventor considers that artificial batteries may be entirely dispensed with, and a circuit formed merely by connecting the aerial current with the earth-current. For instance, to bring Buenos Ayres, in South-America, in direct connection

with New-York, the following plan would be pursued: one electrical tower is erected on Pike's Peak or any other suitable high mountain in North-America, and another similar tower on some suitable peak of the Andes in South-America. The former would, by means of land-lines, be connected directly with Denver, which place is again connected with all the prominent cities of the States. In a similar manner the southern tower is connected by land-lines with prominent cities *viâ* Quito. New-York telegraphs to the tower on Pike's Peak, and, the operator having connected the land-line with the aerial current, the signals are transmitted through the aerial current to the town in South-America, and thence—the land-lines being suitably connected—to Quito and Buenos Ayres. (83)

IRON VESSELS AND THE COMPASS.

WE know that magnets are of two kinds, permanent and induced. The needle of the compass is a permanent magnet. It is also known to scientists that a shell or iron bar laid in the magnetic meridian—north and south—will become temporarily a magnet; and that if struck or smartly jarred whilst in this position, the bar will acquire a certain magnetic polarity quite sufficient to affect the ordinary compass-needle. What of this? Why, an iron ship is but a big bar of iron, which, if running north and south, may be rendered permanently magnetic by the percussion of the waves against its sides, or even by the sharp strokes of the working of its own engines in a storm. Instances far too numerous are on record of the truth of this theory. The Tiber and the Snowdon both lost, or had their magnetic polarity reversed by the sharp blow of a minor collision. The Aphrodita, with a known deviation of her compass-needle of 21° 30′, ran against a pier, and the deviation was lessened by four degrees, showing that in an iron vessel the time when most is required from the compass—perhaps in the dark, when a vessel has struck—that instrument is useless. As to iron cargoes, it has been known that an iron ventilating shaft, placed near the standard compass, has quite misled the navigator. Many methods have been proposed in reference to the remedy of this defect. The latest, perhaps, is that of Mr. Glösener, who suggests "the placing of the standard compass out upon the bowsprit, at a distance previously determined to be without the sphere of attraction of the iron in the vessel. By this means, instead of the attracting substances being grouped around the instrument, perhaps unequally, they necessarily are all upon one side of the compass, and sym-

metrically placed in regard to it. The latter is, of course, so fixed that the lubber's point and the foot of the needle pivot are in a line parallel to the longitudinal axis of the ship. To reflect a portion of the card, an inclined mirror is arranged above it, in which the indication is read from the deck by means of a glass." But some of our iron ships are constructed without bowsprits, even if the method were a reliable one, so that the subject still calls for the earnest attention of our scientific men. For the study of the subject means the saving of valuable property, nay, the saving of innumerable invaluable lives. (101)

NEW EXPERIMENTS WITH THE ELECTRIC CURRENTS.

MM. P. AND A. THENARD communicate to *Les Mondes* the following conclusions derived from recent electrical researches:

1. The vapor of water does not hinder the production of the current, which decomposes it into its constituent gases. 2. The current, while determining the combination of nitrogen and hydrogen, decomposes equally ammoniacal gas; but, in both cases and without absorbent bodies, there is found in the gaseous mixtures a quantity of ammonia quite feeble but sensibly equal. 3. Nitrogen, under the influence of the spark and the vapor of water, disappears to produce an undetermined body which is believed to be nitrate of ammonia. 4. Gaseous phosphuret of hydrogen is similarly incompletely decomposed by the current, and this decomposition is accompanied with phenomena which prove first the formation of liquid phosphorus, then solid phosphorus, and lastly a body supposed to be the same substance in its amorphous state. 5. The current acting on a mixture of gaseous phosphuret of hydrogen and bicarburet of hydrogen reproduces one at least of the phosphoric alkalies. 6. Under its influence the bicarburet of hydrogen alone condenses rapidly into an odorous liquid, soluble in ether but insoluble in water. 7. On the other hand, the mono-hydrate of methylene is transformed in presence of water into marsh gas, into pure hydrogen, into a powerful acid soluble in water, and into a resinous body differing from the viscous substance furnished by the bicarburet. (97)

M. SORTAIS, in France, has invented an electrical device which is placed in the holds of vessels. In case of a leak, or the entrance of too much water into the bilge, a current is established and a communicator is set in operation, signifying the fact to the commander and the officer of the deck.

NEW METHOD OF EXHIBITING THE CARBON POLES.

MR. S. H. LANDY, of Columbia College, New-York City, has succeeded in effecting a decided improvement in projecting the carbon poles upon the screen. The old manner of showing them is to place them behind the condenser in the interior of the lantern, and then throw them upon the screen, giving but a faint and confused image. Mr. Landy's method is to place them in front of the condenser, (a sufficient distance to avoid injuring the glass, about an inch;) and then, by using an ordinary objective, they are thrown upon the screen greatly magnified and clearly defined. The electric current is then established, the carbon poles are drawn apart, and we have a magnified arch of about eight inches, making visible to an audience the transfer of the incandescent carbon from the posititve to the negative pole. By placing caustic potash upon the positive carbon, the arch is greatly extended; by the use of thallium, silver, or copper, the characteristic color of each element is gorgeously depicted upon the screen, making altogether a most beautiful and instructive experiment.

EFFECT OF PRESSURE ON THE SPECTRA OF GASES.

BY C. H. STEARN AND G. H. LEE.—When a current from an induction coil, with a Leyden-jar interposed in the circuit, is passed through a tube containing a gas, say nitrogen, at atmospheric pressure, and the spectrum of the gas is examined, certain phenomena are observed. When the pressure of the gas is reduced, the appearance of the spectrum alters, becoming finally quite distinct from the original one; on the admission of fresh gas, the original spectrum reappears.

The authors show that these changes are *not* dependent on the density of the gas, but depend entirely on the intensity of the charge communicated to the Leyden-jar.

The proof was obtained by passing the charge through two tubes, one of which was sealed, the other capable of being exhausted. On examining the spectrum of the sealed tube while the exhaustion of the other was proceeding, the same phenomena were observed as if the sealed tube itself had been in process of exhaustion.

When the pressure of the gas between the electrodes is high, the discharge does not take place until the jar is fully charged; but as the exhaustion proceeds, a less and less charge is communicated to the jar, until the discharge becomes finally not greater than that of the simple current.

ELECTRIC AND CAPILLARY PHENOMENA.

By G. Lippmann.—The surface of a drop of mercury contained in a glass vessel and wetted with dilute sulphuric acid, quickly contracts, becoming more convex when it is made the negative electrode of a voltaic couple. It has been found by experiment that the contraction is due to a change in the capillary constant, this constant and the force of polarization being continuous functions one of the other; also that an extension of surface produced mechanically is sufficient to polarize the surface as an electric current does.

USE OF ELECTRICITY IN THE MANUFACTURE OF SUGAR.

It is stated by J. A. Morrell, of New-York, that by introducing electrical currents, either independently or in conjunction with currents of air into cane-juice, sugar, liquor, syrup, or other saccharine solution, for about two hours, such a change is effected in the glucose or grape-sugar held in solution with the cane or crystallizable sugar that, on subsequent evaporation of the mass, a much larger crystallization of the latter can be effected than when the evaporation occurs in the ordinary manner. He also states that saccharine solutions may be delayed from fermentation by passing currents of air heated to 212° F. and upward, so as to coagulate the albumen and kill the fungous spores contained therein.

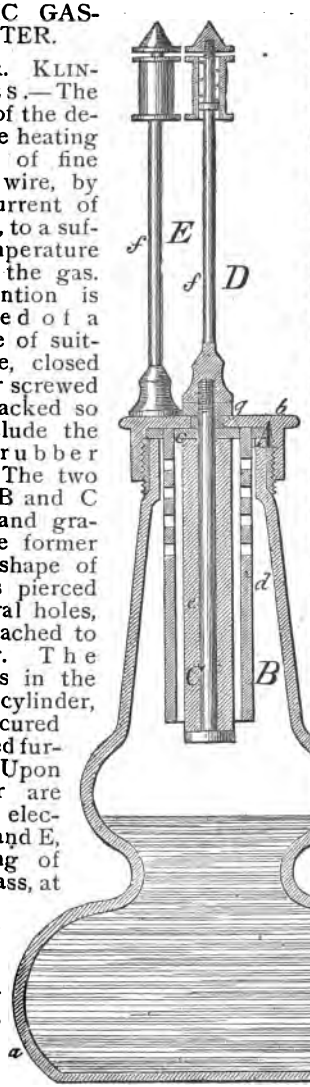
UNSAFE SAFETY-LAMPS.

Mr. Galloway, our English scientist, has lately completed a series of investigations concerning the conditions under which safety-lamps are truly safe. He has ascertained that if a Davy lamp be burning tranquilly in an explosive atmosphere, the transmission of a sound-wave, produced by slight explosion of gunpowder, is sufficient to cause the communication of flame from the lamp to the surrounding atmosphere. Hitherto it has generally been assumed that a colliery explosion, after firing a shot, is due to actual communication of flame from the gunpowder to the fire-damp; but Mr. Galloway's experiments show that the explosion is more likely determined by the noise of the shot promulgated through the galleries of the mine to the lamp. (100)

By means of the spectroscope, astronomers have found that the atmosphere of Uranus is almost entirely composed of hydrogen gas. M. Protier remarks that, if a very small proportion of oxygen also existed there, an electric spark would cause tremendous convulsions by combining the two gases.

ELECTRIC GAS-LIGHTER.

By Dr. Klinkerfues.—The principle of the device is the heating of a coil of fine platinum wire, by a weak current of electricity, to a sufficient temperature to ignite the gas. The invention is composed of a glass vase of suitable shape, closed by a cover screwed on, and packed so as to exclude the air by a rubber plate A. The two elements B and C are zinc and graphite; the former is in the shape of a tube, is pierced with several holes, and is attached to the cover. The graphite is in the form of a cylinder, and is secured as described further on. Upon the cover are the two electrodes, D and E, consisting of rods of brass, at the upper extremities of which are spring clamps whichhold the spiral of platinum wire. One electrode D is attached directly to the cover, the other E carries the graphite cylinder, and is isolated at its point of contact with the cover by a rubber envelope.



The liquid contained in the vase is composed of three parts chromate of potash, four of sulphuric acid, and eighteen of distilled water. To use the apparatus, it is only necessary to slightly incline the vase so that the liquid is brought in contact with the elements. A current is established which heats the platinum by which the gas is lit. On returning the device to its vertical position, the fluid rests at the bottom and the current is interrupted.

The same inventor has arranged a similar plan for the automatic lighting of jets, the ap-

paratus being placed upon the burner. During the day, while the pressure of gas is low, or when the supply is partially or wholly turned off, the liquid is not in contact with the zinc and graphite; but on admitting a greater pressure, the fluid is forced up and a current established.

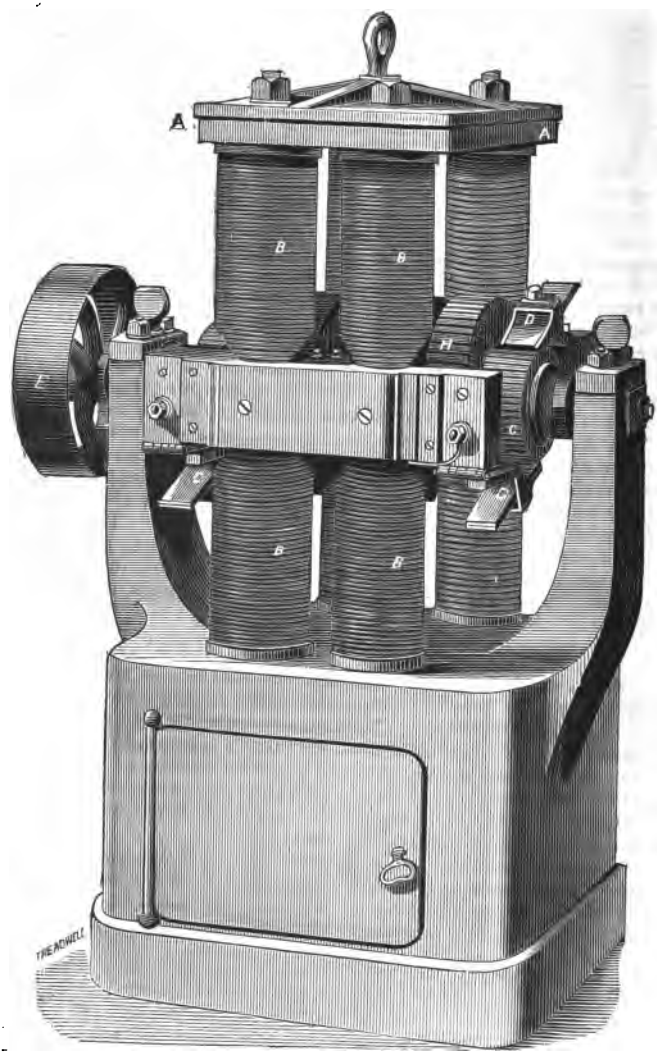
SPECTROSCOPE-MICROMETER.

PROFESSOR ROOD, of New-York, has devised a very convenient eye-piece micrometer for use in spectroscopic measurements. A thin, smooth, semicircular plate of silver is blackened by smoking it, the soot being attached by subsequent flowing with weak spirit varnish. On this dead black surface, and perpendicular to its diametral edge, lines 0.25 millimetre apart are ruled with a dividing engine, the numbers being afterward added. The opaque plate, thus prepared, is placed in the interior of a negative, or, preferably, in front of a positive eye-piece, so that it is in focus, and occupies nearly half the field. A lateral opening in the eye-piece, somewhat nearer the eye, admits the light necessary for illuminating the ruled lines. In general the diffused light of the room is sufficient for this purpose, but if not, a distant lamp conveniently placed accomplishes the same purpose. In this way a set of bright lines is seen in the field of view, more or less bright as the lateral opening is more or less shaded, which may be used with great satisfaction in fixing the position of lines in spectra given either by prisms or ruled plates.

THE SPECTROSCOPE.

IN a lecture on the spectroscope, Norman Lockyer thus sums up the history of its invention, You see, therefore, that our spectroscope depends, first of all, on Newton's work with the prism in 1675; and on the fact, which Newton found out incidentally, that it is important that the prism should be used at the angle of minimum deviation. We then get the slit added by Wollaston in 1812; then the collimating lens added by Simms in 1830. In this way we have arrived at the spectroscope, improved and modified as an instrument, until at last we get spectroscopes so arranged that the glass is of the finest possible material, the angle being the largest possible, the glass the densest possible, and the number of prisms as great as possible.

H. C. VOGEL finds that the light emitted by the sun is less intense near the edges of the solar disk that at the centre; comparing the latter with a point three fourths of the solar radius from the centre, the relations are as 48 to 35. The difference is, in his opinion, caused by the absorption power of the photosphere.



MAGNETO-ELECTRO-PLATING MACHINE.

MAGNETO-ELECTRO-PLATING MACHINE.

ON another page of our Record, we give an engraving of Mr. Gramme's latest improvements in magneto-electric machines, for producing light. We here present a view of the electro-plating machine made on the same principle, by the same author, which was exhibited at the recent Vienna Exposition:

B B are the electro-magnets, A A a cast-iron plate uniting them at the top. The wire is so coiled that poles of the same name are vertically opposite to each other. H is one of the armatures fixed on the same axle as the driving-wheel E. C is the part of the arbor on which the useful current is collected by means of the silvered copper brushes D D. A similar arrangement is placed near E, which transmits a current round the soft iron cylinders, thus converting them into a powerful magnetic magazine. The metallic brushes insure good soft contact, and as they always touch several of the insulated copper strips on the arbor, they cause the current developed to be perfectly continuous. The nuts of these brushes, or any metallic disc more conveniently situated, may be made the poles of the apparatus. The wire coiled round the fixed electro-magnets weighs 270 lbs.; that around the two circular armatures 80 lbs.; the whole machine 920 lbs. The normal speed is about 300 revolutions per minute, and this may be attained by one horse-power. The tension of the current is equal to that of two Bunsen elements, while the quantity equals that of 32.

A NEW GALVANIC BATTERY.

BY J. H. GLADSTONE AND ALFRED TRIBE.—It was shown by the authors that when pieces of copper and silver, touching or connected by a wire, are immersed in an aërated solution of pure copper nitrate, a decomposition of the salt issues, accompanied by a deposition of cuprous oxide on the silver, with a corresponding solution of the copper, and a flow of electricity through the liquid from the positive to the negative metal.

The authors showed, moreover, that this decomposition takes place only when the oxygenized solution of copper nitrate is in contact with the silver, and that it is independent of any action of free oxygen on the copper.

It will be apparent that if free oxygen could be supplied to the solution at the same rate as it combines to form cuprous oxide, the action would go on at about the same rate as long as any metallic copper remained.

To facilitate this as much as possible, the authors arrange that the silver plate shall have a horizontal posi-

tion just under the surface of the liquid in the cell; and, in fact, they convert it into a small silver tray full of crystals of the same metal, which rise in projections above the surface. The copper plate lies horizontally under it, separated, if need be, by a piece of muslin, and connection is made by a wire as usual. Holes are made in the silver tray with the view of facilitating the movements of the salt in solution. The solution itself may be contained in a shallow trough or saucer, and the whole arrangement put upon a wooden stand, the plates being attached to two uprights fixed in the stand. The best proportionate areas of the silver and copper plates were investigated. It thus appeared that an increase in area of the silver plates causes almost a proportionate increase in the current. It was also found that heat greatly increases the activity of this cell; a cell giving a deflection of 40° at 20° C., gave one of 250 at 50° C.; and the increase in the higher degrees of this range of temperature was much greater than in the lower.

The strength of copper nitrate which gives about the maximum effect is 6 per cent.

From the nature of the reaction, it might be expected that the current would gradually diminish on account of the using up of the oxygen in the neighborhood of the silver. Such a diminution always does take place at first; agitating the liquid ought, under these circumstances, to increase the action. It does so.

It might also be expected that upon breaking contact for some time, so as to allow of the absorption of oxygen from the air, the current upon again making contact would be as strong, or nearly so, as originally. This also was found to be the case.

An experiment was made by putting a cell, with plates connected by a wire, under a bell-jar full of air over mercury. It was expected that the mercury would rise inside the jar from absorption of the oxygen. The mercury did rise, and the oxygen was so completely removed that a lighted taper was immediately extinguished in the remaining gas.

Comparative experiments were made with aërated and de-aërated solution of copper nitrate. It was found that the amount of action in the latter case was small and clearly attributable to the difficulty of completely excluding air.

Two experiments were made alike in all respects, except that in one case the cell used was filled with a solution simply deprived of oxygen, while the other cell was filled with a solution through which a current of CO^2 had been

passed for some time. The first was placed in the air, and gave a deflection of 110, rising to 115, but the second was placed in a vessel full of carbonic acid gas, and gave a deflection of 20, which gradually fell to 3.

It was proved experimentally that the cuprous oxide deposited on the silver was compensated by an equivalent solution of the copper plate. The cuprous oxide is sometimes deposited in crystals visible to the naked eye, and shown by a lens to be regular octohedron .

One cell having plates two inches in diameter was found sufficient to decompose such metallic salts as the nitrates of copper, silver, and lead; platinum being used for the negative electrode, and for the positive the same metal as existed in the salt experimented on. Six cells were sufficient to decompose dilute sulphuric acid, and dilute hydrochloric acid pretty quickly, copper electrodes being employed.

The theoretical interest of this battery lies in the fact that it differs from all other galvanic arrangements, inasmuch as the binary compound in solution is incapable of being decomposed either by the positive metal alone or by the two metals in conjunction, without the presence of another body ready to combine with one of its elements when set free.

The practical interest of this arrangement lies in the fact that it is an approximation toward a constant air battery. Should it ever come into use elsewhere than on the lecture-table, it will probably be in the form of a combination of zinc and copper, with an aërated solution of zinc chloride: for that arrangement has an electromotive force equal to six times that of the arrangement we have more particularly studied, and about three-quarters that of a Daniell's cell. (58)

A NEW FORM OF NOE'S THERMO-ELECTRIC BATTERY.

By A. v. Waltenhofen.—The negative wire which is fused to the positive metal is bent back from the point of contact at an acute angle. A small metallic rod is fused to the two elements at this same point. Twenty elements are arranged in a circle, the metallic rods just mentioned being in the centre. The space in the centre is covered with a plate of mica, and the metallic rods are then heated by means of a circular gas-flame.

The electromotive power of twenty such elements is equal to 19.4, one Bunsen cell being equal to 20. If a Daniell cell be equal to 12, then one of these cells is about equal to 1. The resistance of each element = .056. (32)

INTERFERENCE COLORS OF GOLD.

W. STEIN observes that gold in thin plates, or when precipitated from very dilute solutions, (by action of sulphur dioxide in water,) manifests dichroism, appearing indigo blue by transmitted light, but reddish yellow by reflected light. But if the particles of gold be very small, (as when gold is precipitated from its solution by means of stannous chloride,) the laws of interference come into play and the gold appears purple. Such gold the author calls molecular gold, and he thus distinguishes three modifications of gold, (1) ordinary, (2) dichroitic, (3) molecular. Ruby-glass he regards as a solution of molecular gold in glass.

A somewhat similar phenomenon is exhibited in grinding transparent substances to fine powder; they then appear darker and non-transparent. The smaller the particles, the darker their color. The atoms of transparent bodies vibrate in unison with the white-light vibrations of the atmosphere, but when the particles are reduced to small size, some of these vibrations are not taken up by them, but reflected: hence the color now manifested by the substances; and, partly from the change into heat-vibrations of the excess of those vibrations producing white light over those producing colored light, partly from the interference of the different vibrations, heat is produced.

Similar phenomena are shown when sulphur trioxide acts on flowers of sulphur, a liquid being produced which appears blue by transmitted light. This the author regards as finely divided sulphur, held in suspension in sulphuric acid, the acid acting the part of a white screen held behind the particles of sulphur so as to transmit white light through them.

NEW METHOD OF EXHIBITING THE SPECTRA OF METALS.

BY TH. EDELMANN.—A salt of the metal whose spectrum is required, together with some picrate of ammonium, is made into a paste with a little alcohol, and introduced into a hollow cylinder, made of Bunsen's carbon. Any oxyhydrogen flame made to issue from this cylinder is intensely colored, and was found to give a very fine spectrum of any of the following metals: sodium, thallium, strontium, barium, calcium, copper, bismuth.

M. FAYE thinks that the spots on the sun are formed of vapors that are too heavy to be drawn over the photosphere by the hydrogen eruptions.

THE secret of all those who make discoveries is, that they regard nothing as impossible.—*Liebig*.

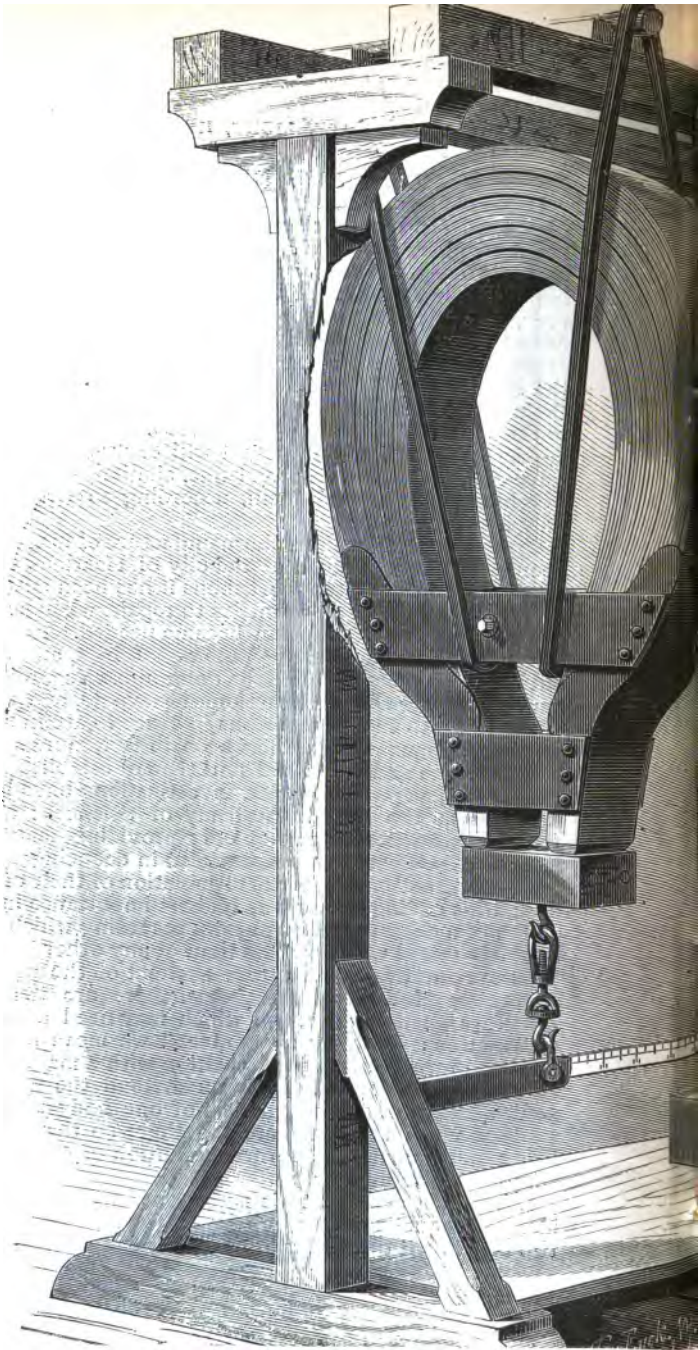
M. JAMIN'S NEW MAGNET.

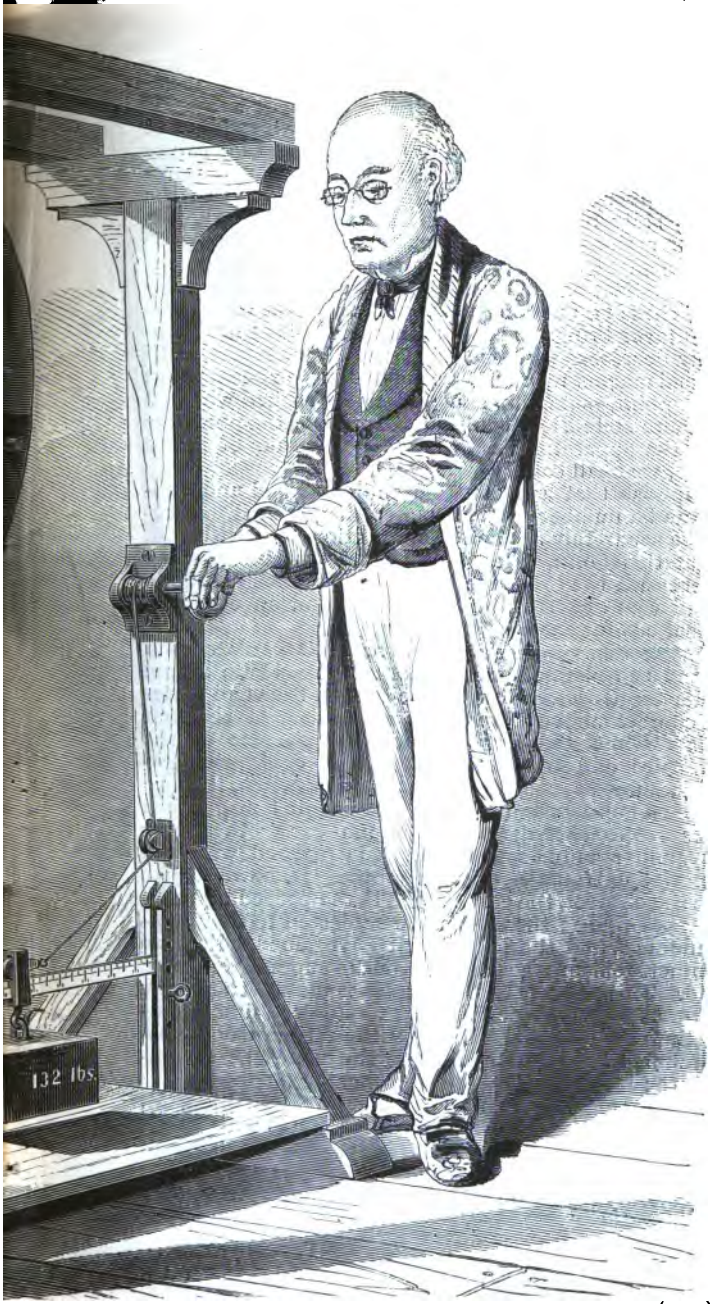
IT is a well-known fact that a compound magnet, formed of a number of plates or layers, each of which is separately magnetized, is possessed of a greater portative force—that is to say, will carry a heavier load—than a simple, homogeneous magnet of equal weight. Generally, however, it has been heretofore considered that this portative force is, as compared with the weight of the magnet, quite small; and Hacker has established a formula showing that the load carried is equal to a constant (depending upon the method of magnetization) multiplied by the cube root of the square of such weight. Thus—to illustrate—while a magnet weighing one pound will exercise a portative force of ten pounds, a second one, similarly magnetized, weighing eight pounds, will, according to the formula, only lift forty pounds.

Up to the present time, the manufacture of magnets has been principally pursued at the city of Haarlem, in Holland; and to the Dutch workshops it has been customary or scientific men of all countries to repair, when powerful apparatus of this description became needed. In spite of the brilliant researches of Coulomb, of Biot, and others, but little has been definitely determined regarding the laws governing the construction of magnets, and notably in reference to their dimensions in order to attain a given power. The manufacture has been, in fact, more a matter of experience and individual skill than of established rule. For some time past, however, investigations have been in progress at the French Academy of Sciences; and M. Jamin has succeeded in not only providing magnets of most extraordinary powers, but also in deducing laws for their construction and for determination of their capabilities; thus adding data of the highest importance in elucidation of a department of physics regarding which it may be safely stated we know less than of any other branch.

Before entering upon a brief abstract of the principles governing M. Jamin's researches, there are two words which we shall employ, and which may need a previous explanation: First, by a "contact" we mean a piece of soft iron brought into juxtaposition with a magnet; and, second, by "dissimulation" is understood the temporary neutralization of the magnetism of one body by that of another when the same are together; so that, on their being drawn apart, the normal condition of each may be supposed to return.

I. When a steel plate is superposed upon a bundle of already magnetized iron, (*faisceau*,) the first effect is, that two equivalent quantities of opposing magnetism separate




132 lbs.

in such a manner that the solenoids, which terminate at the surface of the bundle, appear to prolong themselves through the new layer, so that the magnetic power is referred to the new surface, and nothing is added to the primitive state of the magnet. But the latter produces two other actions: it repulses at its exterior the magnetism of the plate, and also determines in the plate a contrary magnetization increasing with its energy. The difference of these two actions represents the gain which the annexed layer brings to the bundle; and this at first considerably decreases with the addition of new layers, until the normal magnet results. The magnetization becomes, at a certain point, maximum; and a limit is reached which, it may be here stated, is the inferior extreme of the portative force of the apparatus, and which, for the sake of future clearness, we shall call *f*.

II. Suppose that a contact be suitably fixed and supported, and a number of steel plates, magnetized to saturation, be separately applied in connection therewith. M. Jamin, at this point, finds that an indisputable analogy exists between the influence exercised by a magnet upon iron, and that of an electrified body upon an electrical condenser, as, for example, a Leyden jar.

The magnetisms normal to each body dissimulate each other, and the magnet and its contact constitute a true magnetic condenser. Now, in the case of the steel plates and a contact above noted, the magnetism of the first plate is dissimulated by the soft iron; so also of the second, third, and so on, until a point of equilibrium, so to speak, may be considered as reached, when, if more plates be added, a certain quantity of surplus magnetism becomes free. The plates react upon each other, lose polarity, and eventually a new limit is reached, which is the superior extreme of portative force. If, however, we remove the contact, the effect noted in the preceding paragraph takes place; the plates are subjected to their mutual influence, and the lower limit is regained. Replace the contact, remagnetize, and again the superior extreme is found. This we may term F, and it is clearly transitory and without utility, since it disappears on the first removal of the contact; and, although the latter may be returned, unless remagnetization of the plates be accomplished, the lower limit, *f*, remains constant.

III. Arranging two armatures in suitable position, M. Jamin connected his magnetized steel plates with them. If the former touched, he found that they dissimulated all the magnetism of a certain number of plates; but, when separated, only a portion of this property became neutra-

lized. In other words, the plates partially discharge each other, and lose a portion of the normal magnetism; but less than if the armatures did not exist, and still less than before they were separated. Now, by applying a contact to the armatures, a permanent portative force was determined, F_1, greater than f, and less than F. For example, by proper arrangement, F, or the superior limit noted in our second paragraph, was found to be 380 kilogrammes; on removing the contact, F_1 then appeared equal to 260 kilogrammes; on displacing the armatures, f was reached, equal to 170 kilogrammes; on returning the armatures, F_1 was again reached, equal to 260 kilogrammes; and the difference between 170 and 260, in this example, roughly indicates the gain in permanent portative force resulting from M. Jamin's discoveries.

Lack of space forbids our entering in greater detail into the elaborate theories of the investigator. As regards the material composing his steel plates, he adduces the remarkable fact that the degree of temper, retemper, and of annealing necessary is not uniform, and varies greatly with different kinds of steel, a circumstance which explains the hitherto great uncertainty in the construction of magnetic apparatus.

We present herewith an excellent engraving of the great magnet which M. Jamin recently exhibited before the French Academy of Sciences. The apparatus is arranged in a simple machine for testing the portative force, which consists essentially of a graduated lever, on which is suspended a weight of 132 pounds. The latter is gradually drawn toward the end of the lever by a cord, attached to a small ratchet-wheel, shown in the hands of the operator, until contact is broken, when a very simple calculation determines the force. The magnet is constructed of two armatures placed opposite to each other, and each weighing 35 pounds. They are rigidly connected by heavy cross-pieces of copper, and support a cubical contact of soft iron weighing 28 pounds. From their lower ends the armatures spread out and grow thinner, ending in sharp edges. Secured by screws to the exterior surfaces of both is a thin strip of steel, which takes a natural curve from one armature to the other. All the other plates previously magnetized are placed within and left to assume a natural position, clinging to each other, as to the armatures, by their own elasticity. On using from 40 to 45 layers, it was found that the force, F, remained constant, and attained a limit of 1100 pounds, which could not be exceeded with the conditions of armature, contact, and steel used in the experiments. Stopping at 45 plates, the

total weight of the apparatus was determined to be 101.2 pounds, and its portative force 1012 pounds, or ten times the weight. With a greater number of plates, these proportions rapidly diminished, and the power of the magnet no longer bore so high a relative value in comparison with its weight.

As to whether it will eventually be possible to obtain magnetized bars of even higher powers than thus reached it remains yet to discover. Their utility may perhaps be questioned, or at least their direct and immediate application to scientific purposes; but the answer to this, as to every other interrogatory of the *cui bono* nature, is simply that even the most abstract of theories may, in the light of new investigation, lead to other ideas of considerable practical importance. Suffice it that M. Jamin has taught us how to construct, theoretically and practically, a magnet capable of producing the highest effect of which it is susceptible, and that it rests for inventors to apply these newly-found principles toward the improvement or the origination of devices for their scientific and industrial utilization (83)

SINGULAR CAUSE OF FIRE.

THE works of the Rubber Cloth Company, at Naugatuck, Ct., were lately destroyed by fire under the following singular circumstances: The building, an old one of wood, was 100 feet or more in length. The cloth is prepared by treatment with alcohol and linseed-oil, and during the operation is passed over wooden rollers and extended along, for fifty feet or more, into a smaller vulcanizing chamber some thirty feet in length, where it is hung in folds from the ceiling to be dried and heated. The heating is done by steam-pipes. Electrical sparks had often been noticed in passing the cloth along over the rollers. On the morning in question, which was exceedingly cold, the sparks had been observed to crackle louder than usual. A snow-storm was in progress at the time. The workman, who was engaged in hanging the folds of cloth in the vulcanizing chamber, states that suddenly there seemed to come from his hands a sheet of electrical fire, there was an explosion, the whole place was instantly in flames, and himself and others had to run for their lives. The building and contents were soon destroyed. The theory is, that the fumes of alcohol and oil formed an explosive gas in the apartment, which the electrical sparks ignited, just as gas ordinarily is fired by electricity. New works have been put up and the rolling-machines have been connected by conducting wires with the earth.

PRODUCTION OF LIGHT BY ATOMIC MOVEMENTS.

MANY bodies emit light at ordinary temperatures. This fact forms the basis of a speculation by the author, in which he supposes that the atom of a substance may rotate without any appreciable movements of the molecules, and that the production of light may, in many instances, be due to such *atomic* movements.

These movements will depend upon the mass of the atoms and the chemical force binding them together. When these movements are so extensive as to cause a disruption of the molecule, a new substance is formed, accompanied by a greater emission of light. The tension of vapors and the change of volume upon increase of temperature are to be regarded as caused by *molecular* movements. The atomic movements causing emission of light-waves may be taken up by the molecules, and so we have absorption of light.

As the sphere of action between any two atoms must be limited, chemical decomposition will ensue as soon as these atoms pass out of this sphere; if their excursions exceed the distance between the middle points of the neighboring molecules, a complete breaking up of the molecule must ensue. (32)

THE *Journal of Applied Science* claims for Sir Francis Ronalds the credit of having projected, as early as 1818, a system of electric telegraphy. He even went so far as to erect lines of telegraph in his garden at Hammersmith. In 1823, he published a book on the subject, in which he said that the day was to come when the king at Brighton might communicate with his ministers at London as readily as though he himself were in the latter city.—*Galaxy.*

LIGHT-WAVES AND SOUND-WAVES.—A curious instance of the analogies of light and sound is given in *The Medical Times*, from a German medical journal. Two brothers, named Nussbaumer, are said to receive visual impressions from sounds. When a certain note is struck upon the piano, the brothers at once have a sensation of a certain corresponding color, which is not, however, identical for both. Thus the note which produces in the one the impression of dark Prussian blue, produces in the other that of dark yellow. They do not, however, perceive all colors on occasion of hearing sounds. One of the brothers has sensations of yellow, brown, and violet most frequently; while blue, yellow, and brown are most frequent with the other. One of them never has the sensations of red, green, black, or white, awakened by musical notes; though

on one occasion he says that, suddenly hearing a noise from the filing of a saw, he had the sensation of green. No doubt it is very difficult to be secure against deception in such a matter as this; but we may add that Prof. Brühl, of Vienna, after thorough investigation, is satisfied that there is no fraud.

PHOTOMETRY OF COLORS.

MR. WILLIAM M. LOCKWOOD, a practical photographer, read a paper before the National Photographic Association at the recent meeting in Buffalo, N. Y., in which he explains in an interesting and philosophical manner some of the mathematics of light, and the difficulties connected with the photographic production of colors. He says:

"I closed up my window so as to exclude all solar light; then, with a small gimlet, I bored two holes through this covering to my window, about half an inch apart, one over the other. By placing the ground glass so as to cover both these holes, I noticed that the two rays of light, passing through the holes and glass, seemed to unite at a distance of nearly five inches; the same trial with the purple glass made the rays unite at about seven inches; deep blue glass, at nearly ten; red glass, fifteen; and yellow glass, over twenty inches. To me this was a real discovery, because it settled in my mind that colors were of different focal length, and being so, affected or reduced the iodide of silver, in sensitive films, each in a different way. I subsequently ascertained that Tyndall and others had established the focal length of colors, but have not, to my knowledge, determined the irrespective actinic force. I have another theory beside the above mentioned that goes to more fully establish the relative focal length of colors, and at the same time determines, to a certain extent, their actinic capabilities. Dr. Young and Augustin Fresnel, both eminent philosophers, were the first to establish the basis of what is called the wave theory of light. According to data arrived at by these gentlemen, a wave of pure solar light, in a clear atmosphere, is $\frac{1}{45000}$ of an inch in length; that of violet light, $\frac{1}{57800}$; that of blue, $\frac{1}{49400}$; red, $\frac{1}{39000}$; yellow, $\frac{1}{27300}$. In fact, 'the color of light is determined solely by its wave length.' Now the velocity of light being 192,000 miles in a second, if we ascertain the number of waves of each color in a mile and multiply this by 192,000, we obtain the number of waves that enter the eye, or attack the surface of iodide of silver, in a second of time.

"Thus the waves of pure solar light amount to 913,384,192,375,000. In the same interval of time, 699,000,000,000

waves of violet light enter the eye or attack the sensitive film of your plate.

"As violet light stands next to pure solar light in its actinic capabilities, you can easily understand what a large percentage the reflection of solar (white) light has over that of any other, the difference in this instance being 214,384,192,375,000 in favor of white light in a second of time. Now, gentlemen, do you fully understand how it is that the human face, which is possessed of from three to seven distinct colors, tends to solarization in what we term the 'high lights'? Do you see how futile it is to attempt to photograph a red face with white draperies, a yellow face with purple clothing, a sunburnt and freckled face in white linen and laces? Do you not now see at what a fearful discount you work when you attempt to make a finely modeled picture under these circumstances? Do you wonder that so many otherwise good pictures are so flat, white, and chalky in the high lights? Seven eighths of all photographs made, which are failures in lighting and likeness, are attributable to this phenomenon alone. . . . My cure is homœopathic, '*similia similibus curantur*,' or words to that effect. I use different colored reflectors, according to the complexions. If red predominates in the face, use red as a modifier; if blue, yellow, or brown, use blue, yellow, or brown. The rule is: Look for the most non-actinic color in a face, and select the colors of your reflectors accordingly. Why? Because, by flooding the face with any color, you thereby tend to reduce all colors to a mean focus, or to reduce the difference in the length of the waves to an approximate length.

"I tried this theory for several months, and find it works nicely, and will do away with seventy-five per cent of retouching, which is an item nowadays.

"I give you these thoughts, and the use of my system of lighting, free of charge. I have no patent. I have given you the particulars of my theory, not so much to provoke criticism as to provoke thought."

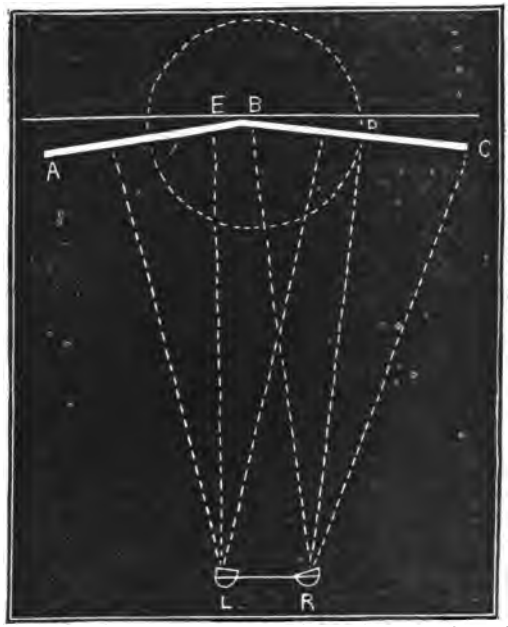
ABSORPTION OF LIGHT BY PHOTO FILM.

PROFESSOR J. W. DRAPER says, The silver compounds of collodion absorb the radiations falling on them, which are capable of producing a photographic effect. Yet sensitive as it is, collodion is very far from having its maximum sensitiveness, as is shown by the following experiment, which is of no small interest to photographers: I took five dry collodion plates, prepared by what is known as the tannin process; and having made a pile of them, I caused the rays of a gas-flame to pass through them all at the same time. On developing, it was found that the first

plate was strongly impressed; and the second, which had been behind it, apparently quite as much. Even the fifth was considerably stained. From this it follows that the collodion-film, as ordinarily used, absorbs only a fractional part of the rays that can affect it. Could it be made to absorb the whole, its sensitiveness would be correspondingly increased.

NEW STEREOSCOPE FOR LARGE PICTURES.

By D. Winstanley.—In the accompanying diagram, I have attempted to indicate the construction of an instrument available for pictures of large size. The two halves of each stereogram are to be mounted on pieces of card-



board, joined together by leather, cloth, or other flexible material, so that the whole may be shut up like a book, with the pictures face to face.

Let L and R indicate respectively the positions of the left and right eyes of the observer, and the lines, A B and B C, the boards or frames upon which the folio pictures rest. The perpendicular pencils of light from the centre of each picture now reach the eye-pieces in converging

lines, which, by transmission through the prisms, may be rendered parallel or divergent to suit the particular theory of binocular vision approved of by the constructor of the instrument. I may observe that parallelism is the idea which accords best with my own apprehension of the subject. After transmission through the prisms, the rays are finally passed through suitable magnifying lenses, whose centres, I apprehend, may be employed for the purposes of vision. The eye-pieces themselves may be constructed of single pieces of glass ground to a spherical curve on one side, (the outside,) and to the refracting angle on the other.

To determine the angular inclination of the pictures to each other, find, first of all, the point, B, at which their juncture shall be placed. Then, with a radius equal to one half the width of the pictures to be shown, describe the circle seen in the figure. From each eye-piece draw a line touching the outside of the circle, and from the centre of the circle draw other lines through the points of juncture. The result is the angle for the pictures. In the right-hand portion of the figure I have drawn lines showing the actual direction taken by the rays in passing from the picture to the prism, and in the left the virtual or seeming direction of those rays.

The advantages I claim for this form of lenticular stereoscope are :

1. That it admits the use of pictures of any size.

2. That those pictures are not mounted on separate sheets of card.

3. That they are, as heretofore, right-handed, and therefore capable of production by any perfected process. (1)

ANALYSIS OF COMPOSITE SOUNDS.

PROFESSOR MAYER recently illustrated, before the members of the American Academy of Sciences, at the Stevens Institute, Hoboken, N. J., his new method of analyzing sounds:

After having first shown experimentally all the existing methods of the analysis of sound, by taking one after another the elementary notes out of a reed organ pipe by the former known methods, he proceeded to analyze the same sound given by the reed organ pipe by his own method, which is as follows: A membrane is placed near the sonorous body. Attached to a point of this membrane are several fibres from a silkworm cocoon. Each of these leads to a tuning-fork. Now it is known that a tuning-fork can only give a simple sound—that is, a sound having only one pitch. Hence if any of the sounds which are

given by these forks exist in the sound given by the sonorous body, the forks giving these sounds, and only these, will vibrate. Professor Mayer showed this by placing on the prongs of the forks small pieces of wax. This system of analysis is found to be so delicate that, if the fork is thrown out of tune by the weight of the piece of wax, so that it will give one beat in eight seconds with the sound which it had before it was loaded, it will thus detect this difference in the pitch. According to Weber of Germany, the most accomplished musical ear can detect a difference of pitch in two notes whose ratio of vibration is as 1000 to 1001; but by this method a difference of pitch can be detected in two notes where the ratio of vibration is 4000 to 4001.

Professor Mayer then gave an account of experiments, in which he has partly succeeded in measuring the relative intensity of sounds by the quantity of heat that sounds give when the bodies producing them are caused to send their vibrations into india-rubber. The rubber is in the form of a very thin sheet, stretched between the prongs of a fork and inclosed on the sides by a thermo battery. Professor Mayer is still conducting researches in this direction. Unless we can measure the intensity of sounds, there is no science of acoustics. Last year, Professor Mayer made an initial step in that direction by measuring with great accuracy the relative intensity of sounds of the same pitch. But to measure the relative intensity of sounds of different pitch is a much more difficult matter, and has not yet been successfully accomplished. Professor Mayer, however, hopes to succeed in this by converting a certain known fraction of a sonorous vibration into heat.

Professor Mayer now exhibited to the Academy the resultant curve produced by combining the first six harmonies of a musical note. This curve was then drawn in a circular disk of glass by removing from its blackened surface the continuous line of the curve, which returned on itself. This curve was now placed in front of a lantern, and the image of the line was projected on a screen. A slit in a piece of cardboard having been placed in front of the curve, and in the direction of a radius of the disk, and the disk being revolved, caused the spot of light on the screen to vibrate like the drum of the ear when it listens to a musical note.

Professor Mayer then proceeded to give an account, illustrated by experiment, of what he supposes to be the organ of hearing in insects. Placing a male mosquito under the microscope, and sounding various notes of tuning-

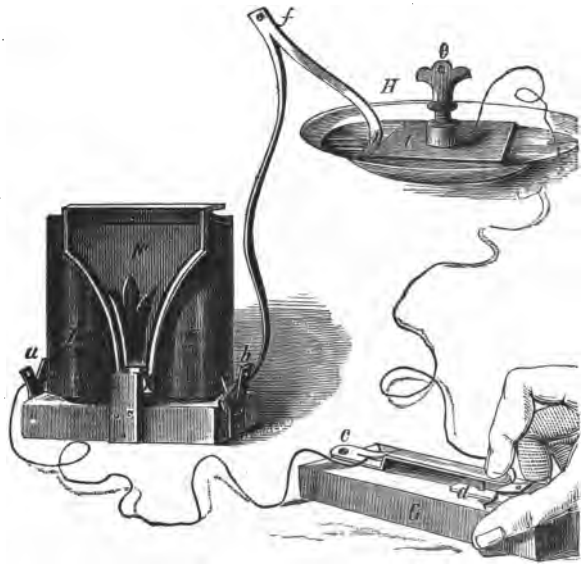
forks in the range of a sound given by the female mosquito, the various fibres of the antennæ of the male mosquito vibrated sympathetically to these various sounds. The longest fibres vibrated sympathetically to the grave notes, and the short fibres vibrated sympathetically to the higher notes. The fact that the nocturnal insects have highly organized antennæ, while the diurnal ones have not, and also the fact that the anatomy of these parts of insects shows a highly developed nervous organization, leads to the highly probable inference that Professor Mayer has here given facts which form the first sure basis of reasoning in reference to the nature of the auditory apparatus of insects.

These experiments were also extended in a direction which added new facts to the physiology of the senses. If a sonorous impulse strike a fibre so that the direction of the impulse is in the direction of the fibre, then the fibre remains stationary. But if the direction of the sound is at right angles to the fibre, the fibre vibrates with its maximum intensity. Thus, when a sound strikes the fibrils of an insect, those on one antenna are vibrated more powerfully than the fibrils on the other, and the insect naturally turns in the direction of that antenna which is most strongly shaken. The fibrils on the other antenna are now shaken with more and more intensity, until, having turned his body so that both antennæ vibrate with equal intensity, he has placed the axis of his body in the direction of the sound. Experiments under the microscope show that the mosquito can thus detect to within five degrees the position of the sonorous centre. To render assurance doubly sure, Professor Mayer, having found two fibrils of the antennæ of a mosquito which vibrated powerfully to two different notes, measured these fibrils very accurately under the microscope. He then constructed some fibrils out of pine wood, which, though two or three feet long and of the thickness of small picture-cord, had exactly the same proportion of length to thickness as the fibrils of the antennæ of the mosquito. He found that these slender pine rods or fibrils had to each other the same ratio of vibration as the fibrils of the mosquito.

ELECTRIC INDICATOR OF AIR.—A solution of palladium chloride is so connected with a battery that, as long as no metal is precipitated, no current passes; but as soon as carbon monoxide occurs in the atmosphere, metallic palladium is precipitated, which establishes a current, and rings a bell to give warning of the presence of the noxious gas.

THE TOM THUMB TELEGRAPH.

THERE is nothing equal to experiment in impressing the facts of science upon the mind. Faraday used to say, with emphasis, to his pupils, that it was not sufficient to read about magnets and electricity. He advised them to make the magnets, use the electrical machines, and thus become, step by step, positively acquainted with the whole subject. As a means to such ends, we take especial pleasure in calling the attention of our readers to the Tom Thumb



THE TOM THUMB TELEGRAPH.

Telegraph. It affords the means of illustrating the phenomena of electricity, at a cost so small as to be within reach of almost every body.

The Tom Thumb Telegraph consists of an electro-magnet, sounding armature, a galvanic battery, telegraph key, connecting wires, and chemicals, all complete for working, which, with excellent directions for use, are furnished for three dollars; neatly packed, and sent to all parts of the world, on receipt of the price, by the makers, F. C. Beach & Co., 260 Broadway, corner of Warren street, New-York.

One of these little instruments is now in operation upon

our table as we write. We had some curiosity to see what could be done with it, and will here give some of the results: First, as to the battery. It is composed of two small plates, one of lead, one of zinc, the latter covered with paper as a septum, both plates set in a common saucer, in water in which a few grains of sulphate of copper are dissolved. This little battery we found, on trial, to run for two days and a half. The water solution needs to be then renewed, which requires, perhaps, a couple of minutes to do.

Next, as to the instrument. It makes a first-rate click signal, and is, we think, just as useful for learning the manipulation of the Morse alphabet, and for sending and receiving messages by sound, as any of the larger and more expensive instruments. The simple alphabet known as the Scientific American Telegraph Code may be quickly learned, and messages received and sent by this instrument, by any person, old or young.

In addition to its office as a signal telegraph, this little device may be used for experimenting in many ways, and with it all the principal phenomena connected with electricity and magnetism may be exhibited. If the armature is removed and a slip of glass, with iron filings, placed on the poles of the magnet, the key pressed, and the glass gently tapped, the filings assume the beautiful positions of the magnetic curves. Removing the glass, needles may be magnetized by rubbing on the poles, permanent magnets made, weights lifted, etc. By connecting one wire with a file and drawing the other wire over the teeth, the electric light, in the form of a sparkling luminosity, may be produced. This is a pretty evening experiment. The electrolysis or decomposition of water into oxygen and hydrogen may be done with the battery, and it may also be used for electro-plating. For these and other interesting experiments, printed directions are given by the makers. For schools, large or small, the device will be found very useful in the hands of the intelligent teacher, as a means of interesting instruction.

We should find it difficult to select an article of more interest and usefulness for young persons than this Tom Thumb Telegraph. It supplies the means for easy self-instruction in one of the most interesting branches of science, with which every body, old or young, ought to make themselves familiar. These little devices may also be used for office telegraphing as well as for home use and amusement. Any intelligent lad may put up the lines and set them in operation. For further information, and free illustrated catalogues, address the makers as above. (83)

AN EASY TELEGRAPH CODE.

THE following is suggested as an easily learned code for general use, by which messages of all kinds may be transmitted with certainty, by means of the ordinary electric telegraphic instruments, and by means of bells, by whistles, by fire-arms or cannon, by lights, lanterns, rockets, or flames, by the flash of reflectors, by flags and levers, by the motion of the human limbs, arms, hands, or fingers. It may be written on paper, communicated by touch, drummed on the table, or transmitted by any of the known means of signalizing. It may be employed with facility by the blind, the deaf and dumb; and will enable people who must talk in church to do so without disturbing their neighbors. It may be learned by any body in five minutes. The code is formed by dividing the alphabet into five sections, represented by the five vowels, A, E, I, O, U. Every body can remember the vowels. For the first vowel, A, make one stroke, flash, sound, or motion; for E two strokes, I three strokes, O four strokes, U five strokes. Make the motions for these section letters quickly, but evenly.

For the remaining letters, give the signal for the section letter, as above, and follow with one stroke for each letter belonging to that section until the letter wanted is reached.

THE SCIENTIFIC AMERICAN TELEGRAPHIC CODE.

The Section letters are ☞	A |	E ||	I |||	O ||||	U |||||
	B ||	F |||	J ||||	P |||||	V ||||||
	C |||	G ||||	K |||||	Q ||||||	W |||||||
	D |||||	H ||||||	L |||||||	R ||||||||	X ||||||||
			M ||||||||	S |||||||||	Y |||||||||
			N |||||||||	T ||||||||||	Z ||||||||||

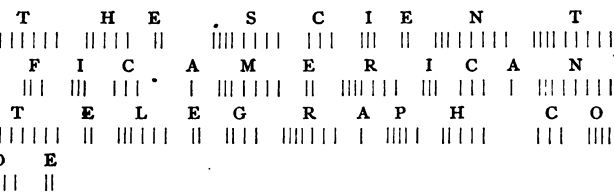
Example: To signalize the letter D, give one stroke for the section letter A, and follow with three slow strokes, the last being the signal for D.

To signalize L: Give three quick strokes for the section letter I, followed by three slow strokes, the last being the signal for L.

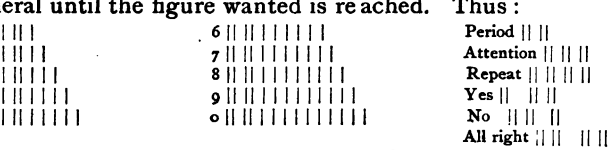
To signalize W: Give five quick strokes for the section letter U, followed by two slow strokes, the last being the signal for W.

The quick strokes are to be made twice as fast as the slow strokes. Practice slowly. Speed will follow accurate practice. After each complete letter signal is given, a space or pause, equal in duration to one quick and one slow stroke, should be made. The space or pause between words is equal to two long strokes.

Example of written message:



NUMERALS, ETC.—To signalize numerals, give two quick double strokes, followed by one slow stroke for each numeral until the figure wanted is reached. Thus:



This alphabet involves the use of many more signals than the Morse; but it is much more easily learned and remembered than the Morse, or any other that has come under our notice.

SECONDARY CURRENTS AND THEIR APPLICATIONS.

BY M. G. PLANTE.—In pursuing the study of the phenomena presented by secondary couples with plates of lead, I have made the following observations: The chemical modification of the electrodes, which constitutes the source of the secondary current, is rendered more complete by alternate charge of the primary current in two directions, with repose between this double action. By the successive action of the primary current in two directions, the deposits of oxide are reduced, and the electrodes are modified in their molecular constitution, not only at their surface, but in their mass. By rest, the deposits formed on the surface of the plates, whether the deposits be of metallic oxides or of reduced metal, acquire a crystalline texture and strong adherence, which contribute to protect the sub-adjacent deposits tending to form themselves under the continued action of the primary current. By following this course of operation, which I have termed the formation of secondary couples, deposits of great thickness may be obtained, admitting in the discharge of calorific effects more or less prolonged. A secondary couple, having less than five and a half square feet surface, charged under the foregoing conditions by two Bunsen elements, will redden a platinum wire of 0.02 inch diameter during twenty minutes, and a wire of 0·008

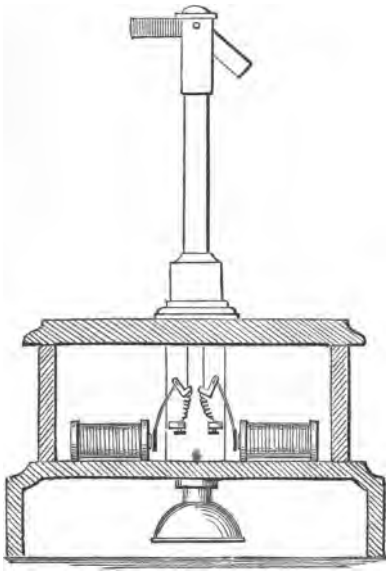
inch diameter for about an hour, without any communication with the primary source, even forty-eight hours after charging. A battery of 16.5 square feet surface, equally well charged, preserved sufficient of its charge to redden a platinum wire for some minutes, a month after charging. Although the formation of the secondary couples necessitates the use of two Bunsen couples, of which we change the direction, with intervals of repose, in order to give the deposits time to take a crystalline aggregation, once this operation is effected, it is no longer necessary to change the direction of the current, and the secondary couples can then be charged by the aid of a very feeble primary current acting constantly in the same direction, such as that furnished by a sulphate of copper element, even mounted with water around the zinc. The chemical work produced by this feeble pile accumulates slowly, but nearly without loss, in the secondary couples, and there will be received, in the discharge, effects of an intensity infinitely superior to that of the primary source. These observations facilitated the several applications of the secondary currents that I have already mentioned, and have led me to construct the apparatus that I have the honor to submit to the Academy. It consists of a small couple perfectly prepared, or formed, contained in a box, of which the base and sides carry a system of connections arranged so as to redden a platinum wire, and to ignite, by simple pressure of a finger on a metallic touch, a wax candle, spirit-lamp, or gas-jet. The battery intended to put the apparatus in action consists of three elements of zinc and water, copper and sulphate of copper, and copper, and is placed at a distance or near the apparatus. It is not necessary to maintain the secondary couple constantly *en charge* under the action of the battery; for, once charged, we can produce a hundred consecutive ignitions. The ignition of a wax candle can be produced instantly, and such method of ignition is very economical and safe. The apparatus may be employed with electric bells in such a manner as to use only three cells of a sulphate of copper battery, being placed in a derived circuit from the primary and in direct communication with the two poles of the battery. It appears that, during the charge of a secondary couple under the action of a battery in whose circuit occur one of several bells, the couple absorbs all the current, and prevents the use of the bells; but, as the secondary couple acquires, under the influence of the battery, a high temporary intensity, it results that it does not act as an inert derived circuit, but itself contributes to the action of the bells. Further, if the battery is rendered too feeble

to work the bells, the secondary couple is capable, by the electricity which it accumulates, of putting them in action. By a combination of the apparatus, not only may sound be produced, but light may be obtained at the same time.

(4)

ELECTRIC RAILWAY SIGNAL.

WE find in *Iron* the accompanying illustration and a description of a new electric semaphore block-signaling instrument, the invention of F. Russell. The apparatus consists in a case within which the armature of an electro-magnet is connected with one end of a rocking-crank lever, the other end of the lever being connected with a wire. When the electro-magnet is excited, the armature approaches it, depressing one end of the rocking-lever and elevating the end in connection with the wire. The latter rises in a hollow column some 18 inches high, and moves a semaphore arm at its upper extremity. Two of these arms—red and white—and two electro-magnets are employed, as represented in the engraving. On the top of the case, a switch lever is arranged which serves to throw the battery current into the line-wire. In front of the instrument is a tapper or ringing key for sounding the bell at the other station. The bell is shown at the lower part of the case.



The device is adapted for use on lines upon which two trains or engines are not allowed to run on the same section of road at the same time. The same signals are used to denote "line blocked" and "line clear" as are actually exhibited to the engineer of the train. In its normal position, the instrument denotes "line blocked," that is, with the arms up. So long as only a current is caused to flow

from the battery to the line will the arm fall to "line clear," because the moment the current is cut off from any cause, the arm flies up to danger, the whole apparatus being in equilibrium. As the red arm can only be lowered from the station toward which the train is approaching, the signal must be under the sole control of the signalman of that station. The white arm is worked electrically by the switch of its own instrument, and shows the signalman the position in which he has placed the electric signal at the other station. In this arrangement, three wires are employed for bell, signals, and arms, for a pair of roads.

THE INVENTION OF THE TELEGRAPH.

THE invention of Sir William Thomson, of a very light mirror from which is reflected a beam of light to indicate signals, in place of a needle or other metallic point, is in use on all telegraphic cables, and increases the speed of transmission over the Atlantic cable from two words per minute up to twenty words. As to the invention of the telegraph, Mr. Latimer Clarke says that there were so many inventors, each of whom had added his quota to the common stock of knowledge, that no one man could be pointed out as the inventor of the telegraph. The first written allusion to the electric telegraph appeared in a letter printed in the *Scot's Magazine*, over the signature of C. W., it was believed in the year 1756. The author of the letter described how he had constructed an electric telegraph between the different rooms of his house by which he could transmit messages of any kind or length.

EFFECTS OF LIGHTNING-STROKES AT GREAT ELEVATIONS.

IT was recently reported that the inn on the Faulhorn, one of the best known summits of the lower Alps, had been struck by lightning and totally destroyed. It appears, however, that although the building was twice struck, it was not damaged, nor did its occupants suffer any injury. The effects of lightning at great elevations seem to be comparatively slight. In 1869, Mr. R. B. Heathcote was struck by lightning upon the Matterhorn. He experienced what he describes as "a sharp, stinging blow upon the leg," and "a hit on the right arm, which seemed to run along it and resemble a shock from a galvanic battery." A week's suffering from a swollen hand was the only inconvenience occasioned by the occurrence.

THE velocity of light is 192,000 miles per second, nearly. The velocity of frictional or static electricity over a copper wire is 288,000 miles per second. The velocity of sound in water is 4900 feet per second.

POSTAL TELEGRAPH CARRIAGE.

OUR engraving shows one of the traveling telegraph-offices now in use in Great Britain for opening temporary communications. The idea is to have a movable office, carrying its own cable, apparatus, and batteries, which can be transported from place to place, either by road or rail, at the shortest notice, and which can be taken to the wires when the wires can not be taken to it. This, which is the only carriage of the kind in use for similar purposes, is constructed to carry one of each of

POSTAL TELEGRAPH CARRIAGE.

the different forms of instrument (six in all) in use in the postal system, and can comfortably accommodate as many as eight clerks in full work. It carries, also, nearly 150 battery cells, and so skillfully is the accommodation designed that these are all stowed away out of sight in odd corners, so that not a single atom of space is lost. Half a mile of three wire iron-sheathed cable is stowed away as snugly as possible in the "boot," and can be paid out and drawn in with the greatest ease in the world. The telegraph carriage has been used at agricultural shows and races, and similar occurrences, which sometimes take place away from cities.

NEW EXPERIMENTS ON COMBUSTION.

By KARL HEUMAN.—By introducing a current of air or oxygen into the inner part of a flame and lighting it there, the author furnishes a neat and convincing proof of the presence of unburnt gas in this part of the flame. The apparatus employed consists of a cylinder 30 cm. long and 6 cm. wide, in the lower end of which are inserted two glass tubes. One of them, 40 cm. long and 1.2 cm. wide, passing vertically through the centre, projects a little over a piece of wire-gauze placed over the top of the cylinder. The other glass tube supplies the interior of the cylinder with gas; when this is lighted, a current of air is driven through the central tube and lighted by raising the latter to the mantle of the flame. On lowering the tube again and depressing the flame with a piece of wire-gauze, the central oxygen-flame is spread out in the shape of a tulip, and surrounded by a sharply defined luminous cone. A beautiful crimson color may be imparted to the inner flame by passing the air-current through a piece of caoutchouc-tubing containing a little powdered strontium nitrate. The use of a double-acting bellows is recommended to obtain a sufficiently continuous air-current.

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ELECTRO-MUSIC REPORTER.

A NOVEL application of electricity to musical instruments, for the purpose of recording the inspirations of genius in musical compositions, is now in process of construction for Mr. C. T. Shelton, of New-Haven, Ct. It is a telegraphic attachment to an organ. Beneath each note of the three manuals and of the pedals, and connected with each stop of the organ, is a small brass spring, which is pressed down whenever the piece to which it is attached is brought into action. From each spring, wires run to a galvanic battery of twelve cells, and to the recording apparatus, which may be situated at any convenient distance from the organ. When the spring is pressed down, connection between the battery and the recording apparatus is formed, and the electric current passes through. The recording apparatus is very simple, and similar to that used in Morse's telegraph. Attached to the clockwork, by which a uniform motion is produced, are two cylinders some eighteen inches in length, between which is carried a strip of paper divided into about 250 longitudinal divisions—one for each note and stop in the organ. Corresponding to each of these divisions is a magnet whose armature carries a lever armed with a style, which indents the paper as long as the electric current is passing through. Now, when any note or stop is brought into

action, the spring connected with it is pressed down, the circuit is completed, the corresponding armature is attracted to its magnet, and the division of the paper belonging to the note struck is indented with a line proportionate in length to the time during which the note is held down. A staccato touch will be represented by a simple dot, while a longer tone will be recorded by a more prolonged indentation. The clockwork is so geared that the paper is carried forward on the rollers at the rate of about one half an inch per second, thus recording each note in the most rapid playing at the rate of about ten notes per second by a line one twentieth of an inch in length, and longer notes by lines proportionally extended.

EXPERIMENTS WITH LIGHT AND ELECTRICITY.

ADJUST a prism so as to get a well-defined solar spectrum, bring the violet rays to a focus on the eye of a fine cambric needle made so hard that it will scratch glass; this will magnetize the needle, proving that light will produce magnetism, by which a current of electricity may be induced in a small coil of very fine wire connected with the binding posts of a sensitive galvanometer; a slight movement of the galvanometer needle each time the magnetized cambric needle is caused to enter the coil, and a movement in the opposite direction when it is withdrawn, delicately prove the correlation of light to magnetism and electricity.

PRIMARY ELECTRICITY.

BY ROBERT SABINE, C. E.—As a general rule, I believe it may be safely stated that, whenever the surfaces which are in contact of two heterogeneous bodies undergo any physical change, they have a tendency to take opposite electrical states. Thus a glass rod and a piece of flannel lying together appear to have no tendency to develop electricity between them; but the moment their surfaces are rubbed together, the one becomes positively electrical and the other negatively so. A piece of antimony and a piece of bismuth lying together, under the same conditions of temperature, show no signs of electrical tension; but directly we change the temperature of their points of contact, we set in action a thermo-element, and get a measurable tension. If the point of contact be heated, the electrical polarization is in one direction; if it be cooled, it is in the opposite direction. There are, of course, bodies whose natures are such that they can not come together at all without a change taking place, and therefore can not come together at all without developing a mutua lelectrical tension. Thus it is with bodies which exert a chemical ac-

tion upon one another, or have a natural tendency to absorb or combine with each other ; for instance, a plate of zinc dipped into water strives at once to combine with one of the constituent parts of the water—to become oxidized —and the water and the zinc therefore assume at once opposite electrical states. And possibly all metals, which are in oxygen, or even in atmospheric air, may be in the same condition, which would account for the electrical tension that Kohlrausch and others assert to have discovered by simple contact.

May not the explanation of these phenomena be that every body lying upon the earth's surface contains an amount of latent electricity according to its electrical capacity, just as every body lying upon the earth's surface contains an amount of latent heat according to its caloric capacity ?

LIGHTNING-RODS.

IT is supposed by Charles and Gay-Lussac that a lightning-rod protected an area whose radius was double the height of the rod extending above the building, but this rule is no long reliable, by reason of the extensive use of metals, in the shape of pipes, etc., in the construction of the buildings of our day. When electricity finds several paths to the ground, it will prefer the best, it is true ; but some portion will also pass along the poorer conductors. If, therefore, any metallic substances lie within the area supposed to be protected, they are in danger of being struck. This is especially true where the lightning has a chance to jump to the gas and water pipes of a building. It is a good plan to connect these pipes with the lightning-rod ; if the rod is struck, the electricity will then have an excellent path into the ground, and will be rapidly diffused over the vast underground net-work of pipes. The danger to the inmates of the house of being struck from these pipes is less than that of receiving a shock from the powerful induced currents liable to be developed in them, if unconnected, during a thunder-storm. People are apt to be indifferent whether their houses and stores are provided with lightning-rods or not, and are always ready to give an example where some building so provided was struck in spite of its protection. Such cases have undoubtedly occurred, and they are often quoted by the old-fashioned "practical men" with much satisfaction, because they hail in them what they are pleased to call the victory of their sound common-sense and the discomfiture of the scientific man. This class is, however, rapidly diminishing in numbers, under the influence of the extensive diffusion of scientific education among the people by popular lectures

and by the press. It may be well to assure unbelievers that the efficacy of the lightning-rod is no longer an open question, and that any failures are attributable to bungling or ignorant construction. It would be an easy matter to multiply statistics in proof of the assertion ; but none would carry with them more force than the following statement obtained from the records of the British Navy : Formerly, the annua ldamage to ships by lightning involved an expense of £6000 to £10,000. Between 1810 and 1825, no less than 35 sail of the line and 35 frigates and smaller vessels were completely disabled ; and in 200 cases recorded, 300 seamen were either killed or injured. When the lightning-rod was introduced, every mast was furnished with a capacious conductor permanently fixed and connected with bands of copper passing through the sides of the ship under the deck beams, and with large bolts leading through the keel and keelson, and including, by other connections, all the principal metallic masses employed in the construction of the hull, (Harris.) Since the adoption of this arrangement," it appears that damage by lightning has positively vanished from the records of the navy." In one case,while the small frigate Conway was under refit in the harbor of Port Louis, the topgallant-masts were down on the deck, and a small spar, not having a conductor, was substituted for the time to support the pennant. A thunder-storm came up, and the spar was shivered to atoms. No further damage was done, however, for the conductor on the topmast below the spar immediately carried off the terrible flash. No further examples are needed to prove that a lightning-rod constructed according to the principles set forth is a protector to life and property. 83

THE END OF THE UNIVERSE.

IT is supposed that the resistance of the ethereal medium, shown to exist by the undulatory theory of light, will gradually cause the satellites to fall into the planets, the planets into suns, and suns into a common centre, after which darkness, silence, and death will reign.

THE experiments of Dr. Steintz show, that when electricity is sent through soft steel, copper, brass, or platinum wires, an elongation thereof takes place equal to about one fifth of the elongation produced by heating the wires.

THE pressure produced by gunpowder upon a cannon-ball is estimated by Papillon at 75,000 lbs. per square inch.

THE temperature of ignited gunpowder is estimated to be 2500°F.

(252) JOSEPH NORMAN LOCKYER. (SEE BIOGRAPHY.)

MECHANICS AND ENGINEERING.

COMPLETION OF THE GREAT BRIDGE ACROSS THE NIAGARA RIVER.

THE great international bridge across Niagara River from Buffalo to Fort Erie, in Canada, has been lately completed. The Buffalo *Commercial Advertiser* furnishes the following interesting description:

"To state the facts roughly but plainly, the entire length of the bridge is about three quarters of a mile. But more in detail the length is as follows: In the main river, 1800 feet; over Squaw Island, 1300 feet, (trestle-work,) and over Black Rock Harbor, 450 feet. The entire length of the superstructure in the main river is 1890 feet; in Black Rock Harbor, 440 feet. There are nine spans in the portion on the main river and three in the Black Rock Harbor: four of 190 feet in the clear, and three of 240 in the clear. Over the main river also are two draw-openings, of 160 feet each; total length of draw-girder, 362 feet. In Black Rock Harbor are two draw-openings of 90 feet each, and one fixed span 220 feet in length. In the main river are eight piers and two abutments; and in the harbor, two piers and two abutments. The abutments are 40 feet long by 30 wide at the bridge-seat level. Over the bridge is laid a track for railroads, and a common sidewalk for foot passengers. The piers and abutments are built of sandstone from Georgetown and Acton, Canada, and from Berea, near Cleveland, Ohio.

The iron of the superstructure was from the Phœnixville Iron Company's Works, Phœnixville, Pa. The first caisson was launched on the 13th of July, 1870, and work progressed steadily up to the time of completion. It must be remembered, that the current of the river, at the point where the bridge is located, runs from five and a half to ten miles an hour, according to the state of the wind. This was throughout one of the greatest difficulties encountered, and frequently retarded progress. Then, too, the depth of water varies from twelve to forty-five feet. The ice in winter, some may think, would damage the bridge in course of time, but the ice-breakers afforded ample protection, and cut to pieces blue ice two feet thick with comparative ease. Another remarkable thing connected with the history of the bridge is that, during the whole course of the work, not a single life has been lost. The workmen have, many of them, often been exposed to dangers, but always have escaped.

The respective weights of the different spans over the river are as follows: 190 feet, 130 tons; 240 feet, 208 tons; 362 feet draw, 353 tons; and the entire quantity of iron used in the whole bridge amounts to upward of 2000 tons. At the request of Captain Tyler, the English Government Inspector of Railways, who visited the bridge in November, 1871, on behalf of the English shareholders, one of the spans of 190 feet was loaded with 210 tons of iron rails, equally distributed over the floor-beams, (a weight greater than that of a continuous train of locomotives covering the span,) and left in that condition for three days. This test was highly satisfactory, the deflection being found to be only about one inch, and the truss returning exactly to its former condition on the removal of the load.

The bridge has been leased to the various railroads which will cross it, for twenty years. The roads are the Grand Trunk, the Great Western, the Canada Southern, the New-York Central, the Erie, and the New-York, West-Shore, and Chicago. Most of these railroads have already constructed their approaches to the bridge, and will commence sending trains across at as early a day as possible. The original plan contemplated a carriage-way, but this was abandoned for the reason that, as the bridge was three quarters of a mile long and so many trains were to cross it, there would very seldom be a chance for carriages to cross without interfering with the trains.

The entire cost of the bridge, in round numbers, is not less than $1,500,000. Of its practical benefits we leave the reader to judge, merely stating in conclusion that it supplies a want long felt by the different railroads which have for so many years been obliged to cross the Niagara River on the steamer International.

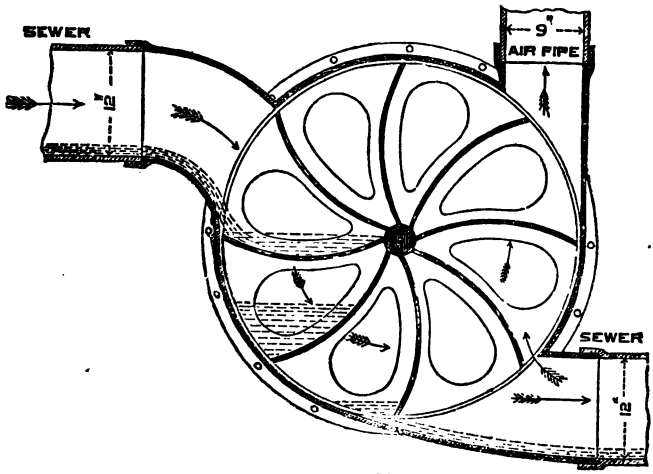
PREVENTION OF CORROSION OF STAY-BOLTS IN BOILERS.

THE stay-bolts used for securing the water-tables of steam-boilers are found to rapidly corrode, owing to the original skin of the iron being removed by the cutting-dies in forming the screw-thread thereon, and, to overcome this difficulty, John Cochrane, of New-York, proposes to case-harden the threaded bolt; whereby he claims that it is made as durable as the plate to which it is fastened, instead of corroding in one third the time, as is the case with those not hardened.

THE velocity of circular saws at the periphery is from 6000 to 7000 feet per minute, or from 70 to 80 miles per hour.

VENTILATION OF SEWERS.

THE annexed diagram represents one of a series of fans placed in the line of a sewer, with an air-pipe from it, supposed to be in connection with the atmosphere above the houses. It is the design of Mr. John Phillips, given in the *Builder*. By causing the sewage to fall into the fans on one side near the top and to escape on the other side at the bottom, they are made to rotate, draw air out of the sewer, and force it up the pipes into the atmosphere. The fans, therefore, are self-acting; and, if properly constructed and fixed, will not get out of order. If, in addition to the usual drain communications, pipes are laid from the open air into the sewer, at points midway or



VENTILATION OF SEWERS.

nearly so between the fans, it is evident that the air-currents, established along the sewer by the rotation of the fans, will remove the gases as they emanate from the sewage. Thus the power of the water flowing in the sewers not only carries off the sewage, but, by falling into the fans, with air-pipes to and from the sewers in connection with the atmosphere, it is made available for ventilating the sewers as well.

FRICTION OF JOURNALS.

IT is frequently asked whether the friction of a large journal is greater than that of a small one, the length and character of bearing being the same in both cases, and

the number of revolutions the same, the only difference being in the diameter of the journal.

The friction on any surface, whether plane or cylindrical, is proportional to the weight resting upon it, and is not at all affected by the area of the rubbing surface, provided the pressure is not so great, on the one hand, as to change the character of those surfaces, nor so light, on the other hand, as to make the resistance principally that of viscosity of the lubricant rather than that of true friction. In the former case, the friction may increase immensely in consequence of the cutting of the surfaces; and, in the latter, the increase of frictional resistance will be approximately proportional to the increase of area.

The work done in any given time, that is, the power wasted in turning any journal on its bearings, is, where the frictional resistance is the same, proportional to the speed of the rubbing surfaces, since it is measured by the product of the resistance into the distance through which that resistance is overcome. Therefore, it follows that a very large journal absorbs a larger proportion of the driving power of a machine than does one of small diameter, and in designing machinery we should make journals of as small diameter as possible without danger of breaking the shaft, or of causing abrasion of the rubbing surfaces.

Again, the tendency of a journal to heat is the greater the greater the pressure per square inch of longitudinal section of the journal, and it is increased by increasing the speed of the rubbing surfaces. Therefore, to make journals safe against heating, make them of as small diameter as safety permits; and having thus reduced their absorption of power to the lowest limit, secure bearing-surface by giving them ample length. If they are, however, made so long that the shaft can spring in the journal, heating may occur from that cause; in line-shafting, this will, of course, not happen. The best practice gives line-shafting for mills a length of journal equal to four times the diameter of the shaft.

There are rules known to engineers, for properly designing journals, which are based on the principles above stated. The earliest of which we have knowledge is that of Professor R. H. Thurston, which was based upon observation of the action of crank-shafts of naval steamers in 1862. A somewhat similar rule, based on locomotive practice, was published by Professor W. J. M. Rankine in 1865. The first is expressed as follows:

$l = \frac{PV}{60000\,d}$; and $\frac{p}{ld} = \frac{60000}{V} = p$. The second is, $\frac{44800}{V \text{ plus } 20} = p$; and, when reduced to the same form as that of Professor Thurston, becomes $l = \frac{P(V \text{ plus } 20)}{44800\,d}$

Here l = length of journal in inches; P = total pressure on journal; p = pressure per square inch of longitudinal section; V = velocity of rubbing, in feet per minute; d = diameter of journal in inches.

In no case in general practice should the pressure, on even the slowest-moving journals, be allowed to exceed 1000 pounds per square inch of longitudinal section with steel journals, or about 600 on iron, running in well-worn boxes in each case.

Special care should always be taken to provide for effective lubrication. (83)

THE PREMATURE DECAY OF TIMBER.

MR. HECTOR ORR, in a paper on the above topic, communicated to the *Journal of the Franklin Institute*, gives conclusions drawn from an examination of the timbers of the U. S. ship Chattanooga. This vessel was built in Philadelphia, but never left the Delaware. Last winter, she was injured by the ice and partially sunk off League Island. Her keel was laid less than eight years ago, but at the present day her timbers are so rotten that they fairly crumble under the touch. Near the forward bends, the timbers were doubled. The writer noted one or more instances in which a pine log and an oak log were thus coupled, and the decay had evidently begun at the inner surfaces, which were in direct contact with each other; but even where both logs were of the same wood, the same inward decay appeared. Whether in the undisturbed mass or where pierced with iron or copper fastenings or even with the treenail, the fibre was completely broken up.

The fleet of Commodore Perry, which was built in haste from timber cut on the lake shore for service in the war of 1812, suffered from early rot, so that the vessels were pronounced unseaworthy soon after the peace of 1815. In some vessels, a strange tendency to decay has been noticed, indicating a sort of triennial crisis in their early life, which, if passed without injury to the wood, predicted some twenty-five years of wear. Marked instances have been observed in large pieces of timber, such as pillars, girders, and even rafters, that were cased with light boards to improve the appearance of the room, the inner mass being found dangerously rotten. Another important fact is, that in portions of the "lining" of vessels covered with zinc or tin, as in provision-closets, etc., the decay followed exactly the surface covered by the metal, indicating the action of "dead" air in contrast with that of a free atmosphere on the surrounding parts which remained sound. The hygienic condition of a decaying structure is worthy

of consideration. It has been determined that in all well-ascertained centres of production and diffusion of yellow-fever, three conditions were always present, namely, heat, moisture, and decayed wood. The danger in such a vessel as the Chattanooga is obvious. As to moisture, her mere bilge-water would furnish this, even without the drippings from tanks and boilers ; the heat is insured by her furnaces, which a cruise in the tropics would aggravate, and the rotten wood, as was evident, existed at once in profusion and perfection.

AIR-POWER.

AT Brunswick, Me., on the Androscoggin River, some three fourths of a mile below the railroad station, is the site of a mill, long since burned, and the motive power which operates the condenser is a water-wheel at the place. The wheel, it is said, is capable of driving four condensers of equal power with the one now in use. At the railroad station is an engine of ten horse-power, running circular saws for sawing wood and various machinery in the blacksmith's shop in the vicinity. Thence a small pipe passes on through the village, furnishing power to Worthly Brothers, jewelers, who are running a small engine of about one horse-power. Parent & Dafriend also use an engine of two horse-power in their blacksmith-shop ; Dennison & Co., box-makers, an engine of two horse-power, and Professor Brackett, of Bowdoin College, one of three horse-power, for the manufacture of instruments, while the laboratory of the College has one of six horse-power. So that, nominally, this small condenser furnishes in all twenty-four horse-power, and all unite in saying that the air-power is much more efficient than steam in working the same engines; it does not drag, but recovers itself instantly from any strain or check, and is in every way a success.

The employment of pneumatic power for industrial purposes is constantly increasing. By its use, the Mt. Cenis tunnel, through the Alps, seven miles in length, was bored. The Hoosic tunnel, in Massachusetts, five miles in length, now nearly finished, is being cut by the same means. The St. Gothard tunnel, in Switzerland, lately commenced, which is to be thirteen miles in length, will also be cut by means of compressed air. The Hell-Gate rocks, under the East River in this city, are in process of removal by the same agency. In planing-mills, the pneumatic method is used to carry the shavings from the planers to the furnaces of the steam-boilers; in grain and wool houses, to convey the stock. At the iron furnaces,

pneumatic elevators are used to lift the cars and their loads of ore from one point to another. In London, the pneumatic method drives five-ton freight-cars in tubes under ground; the post-office department of that city has now in use several miles of pneumatic tubes laid under the streets, in which letters are conveyed with great rapidity. In this country, the largest scale on which the system has been applied is at the works of the Pneumatic Transit Company, on Broadway, where a railway passenger-car, running in a nine-foot tunnel under that street, is operated by compressed air.

EFFECTS OF STRESS ON METALS.

PROFESSOR R. H. THURSTON considers that he has substantiated the fact that metal, strained so far as to take a permanent set and then left under the force-producing stress, actually gains in power of resistance up to a limit of time, which in these experiments was about seventy-two hours, and to a limit of increase which has a maximum, in the best irons, of about twenty per cent. We need hardly point out the importance of this conclusion, which, though it has been suspected for some time by many engineers and men of science, is now for the first time definitely proved. The result is of course negative, and necessarily completely upsets the common notion that metal continuously strained beyond its limit of elasticity loses its strength.

We understand that further experiments will be speedily made, so that we hope to be enabled before long to lay before our readers more detailed information, together with copies of curves and other interesting results obtained. We note with pleasure that numbers of specimens of cast, wrought, and malleable iron, steel, and many other varieties of metal, are being sent to Professor Thurston by prominent manufacturers in all parts of the country; so that the coming investigations bid fair, not only to add greatly to the already well-earned reputation of their author, but largely to the knowledge of the scientific professions.

ERECTION OF BRIDGES WITHOUT STAGING.

IN some cases, the rivers over which bridges are to be erected, or the exigencies of navigation, make it inconvenient to erect false-work or staging. Thomas C. Clarke, of Philadelphia, therefore, suggests that metal bridges may be built in halves on each shore, supported and balanced on suitable piers, turned around on turn-tables, permanently secured where they meet, and then furnished with rollers to admit of usual expansion and contraction.

DRIVING-POWER OF LEATHER BELTS.

THE driving-power of a belt may be limited by either of two things, its friction on the pulley or its strength. If it slip easily on the pulley, the limit of its driving-power is reached long before it is strained to its maximum of strength, and, consequently, the belt is inefficient. If the friction is very great, the belt yields, if overstrained, by breaking, or by tearing out the lacings.

To secure the best effect, the endeavor should always be made to obtain the greatest possible friction on small pulleys, and the strongest possible belts and lacings, or other connections, where the pulleys are large.

The relative frictional values of different surfaces over which belts may be run are given, by experiment, as follows:

Pulley of iron, covered with leather....	35	per centum.
" " polished.....	30	"
" " turned but unpolished..	15	"
" wood, hard and polished.....	25	"

To obtain greatest friction, the grain side should be placed next the pulley, as the friction is very much greater when so placed. The neater appearance of a belt placed with grain side out must be sacrificed if full efficiency is to be attained. This difference sometimes amounts to one third. With the grain side to the pulley, there is less liability to crack also. Where pulleys are driven at very high speed, centrifugal force has the effect of reducing the pressure of the belt on the pulley, and thus of diminishing its friction.

The strain which is allowable upon a belt is variously estimated by different authorities, but is most frequently given at about 300 pounds per square inch of cross sectional area.

C. D. Abel gives one sixty-fourth of a square inch for each five pounds, or 320 pounds per square inch.

General Morin gives 355 pounds as the strain, per square inch, which may be borne for a long time without injury.

Haswell gives 350 pounds.

From the facts stated, it will be seen that the width of belt required will be determined readily, when the power to be transmitted is known and the speed at which the belt is run.

Mr. J. H. Cooper, whose papers in the *Journal of the Franklin Institute* (January, 1869, p. 42) we have referred to before, gives the following, on authority of Professor Thurston:

$$W=\frac{7000\times HP}{S\,V}; \qquad W=\frac{700{,}000\ HP}{S\,V\,t}$$

The circular of Hoyt Bros. gives $W=\frac{5334\ HP}{S\,V}$

W=width in inches; HP=horse-power transmitted; V=velocity of belt in feet per minute; S=length in feet of that portion of the circumference which is covered by the belt; t=tension.

That is, by the first rule, divide 7000 times the horse-power by the product of the velocity of the belt and the length of that portion of the smaller pulley which the belt touches; the quotient is the width required in inches.

An old rule among millwrights allows a belt one inch wide, running 1100 feet per minute, for a horse-power.

Care should be taken in putting up belts to lace or otherwise unite them so as to obtain a uniform strain across the whole width of the belts. Long belts should be used where possible.

Properly proportioned for its work, well made, well placed and properly cared for, a good belt should last many years, and then, if wide, may be cut into narrower belts for lighter work, and good service be obtained from it in its new application.

The pulleys should be turned and polished, or, when small, covered with leather. They should be carefully balanced for high speeds, and, in many cases, tightening pulleys will be found convenient, and sometimes indispensable, for adjusting tension. (83)

NEW FIELD-GUNS FOR THE FRENCH ARMY.

THE new French field-gun, the *canon do sept*, which is constructed by Colonel Reffye, and likely to be adopted as the principal field-gun of the army, is, says *Engineering*, made of bronze, with a bore of 8.5 centimeters, length of barrel 187.5 centimeters, and contains 14 grooves, 1.5 millimeters deep, these being twisted from right to left at an angle of 8 deg. 32 minutes, or of 21.2 calibres to a complete twist. The breech-closing apparatus is a screw, which fits in a steel nut that is inserted in the end of the barrel, flush with its end face. Screw and nut have their threads cut out at three sixths of circumference, so that the former may be inserted in the latter by simply pushing it inward, when it is fastened in it by a turn to the right of $\frac{1}{6}$ of its circumference. The screw rests in a kind of swing-door, similar to the first Prussian model of field-gun with piston-breech, which supports it when drawn out of the barrel, and facilitates its insertion. The inner head of the breech-screw has a slightly concave surface, and

bears on the side three twist grooves, which arrangement is intended for extracting the metallic cartridge-shell, which serves as gas-check. This shell consists of a thin brass bottom, which is provided with a perforated ignition-cup, while the cylindrical part is made of tinned sheet-iron. The touchhole is bored at an angle through the breech-screw and opens at the centre of its inner surface in the gun just where it meets the ignition-cup, so that the fire ignites the cartridge centrally. The latter consists of 5 disks of compressed gunpowder, each weighing 0.226 kilogramme, and provided with a central canal of 5.2 centimeters in diameter; their total weight is 1.13 kilogrammes. The projectile is an elongated shell, 3 calibres long, weighing 6.9 kilogrammes, and is provided with two lead rings as guides. The first trials with this gun, at the Polygon of Vincennes, date back as far as 1870; but only in 1872 was it tested again at Calais in its improved form, and its chief merit seems to be its low trajectory, though it may leave something to be desired with regard to range, accuracy, and durability.

RECENT GUNNERY TRIALS.

THE special board appointed to make comparative trials of howitzers, field-guns, and mitrailleuses, assembled at Fortress Monroe, on the 1st of October, and closed their labors on the 6th. The trials were made under direction of General Gilmore, President of the Board, assisted by Colonel Treadwell of the Ordnance Department, and Captain Lorraine of the Artillery. The trials were made on the seashore near the fort, the target being 9 feet high and 40 feet long.

The guns tried consisted of the ordinary Napoleon 9-pounder field-gun, carrying 12 lbs. canisters, weight of gun about 900 lbs., worked by 8 men, range of firing 800 yards; the ordinary 8-inch field howitzer, weight of gun about 2500 lbs., worked by 8 men, range of firing 800 yards; the small Gatling gun, calibre .42, weight of gun 200 lbs., worked by 2 men, range of firing 800 and 1200 yards; the one-inch Gatling gun, 900 lbs., worked by 4 men, using canister cartridges each containing 21 half-inch balls, range of firing 800 and 1200 yards.

The remarkable advantages of the Gatling gun were never more thoroughly established than on this trial. At 800 yards, the small gun threw 600 shots in 90 seconds, of which 515 hit the target, being from 8 to 10 times more than the hits made by the howitzer and field-guns.

At 1200 yards range, the latter guns, owing to some de-

fect in the ammunition, were withdrawn, to be tried on another occasion.

At 1200 yards range, the Gatling guns, both sizes, exhibited great success in striking the target with deep penetration. The heavy Gatling threw 5355 missiles in 90 seconds, of which 1595 struck the target. These are remarkable results, and have probably never been surpassed in this species of gunnery.

THE MOST POWERFUL GUN IN THE WORLD.

THE new reinforced siege-guns lately added to the German artillery, of 21, 28, and 30½ centimeters rifled bore, are said to be the most powerful guns in the world. Their performances are truly remarkable. The last-mentioned gun, with 120 to 130 lbs. of prismatic powder of from 1.74 to 1.76 specific gravity, fires a chilled cast-iron shell of 600 to 610 lbs. weight with an initial velocity of 1607 feet per second, which is said to have never been attained before by any rifled-gun. At a distance of 1200 paces, or 988 yards, it sends the shell clean through a 14-inch armor-plate and backing. The gun is very handy and easily manœuvred; it requires one man to handle the breech-piece, two to lift up and insert the shell by means of a davit-lift, two men to give it its greatest elevation of 17 deg. in 16½ seconds, or its greatest depression of 6½ deg. in 11 seconds, and two men to give it its lateral direction by means of a chain running over jack-pulleys.

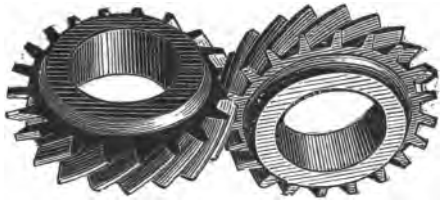
NOVEL STEAMER.

THE saloon steamship designed by Mr. Bessemer, to make sea-sickness impossible, is well under way at Hull, England. The framing is nearly complete, and a good part of the outer plating has been put on. The steamer is 350 feet long, 40 feet broad inside of her paddle-boxes, and of 2774 tons burden. She will be driven by two sets of paddle-wheel engines, acting upon a double set of paddle-wheels, situated 100 feet apart, the aggregate power of the engines being no less than 4600 horse-power. The two ends of the ship are alike, and each will be furnished with a rudder. Her most characteristic feature is her saloon, which will be 70 feet long and 30 feet wide, and suspended upon massive pivots at the centre and at the extremities. Thus supported, it will be brought under the control of powerful hydraulic gear, worked by the principal boilers of the ship. This gear will be so arranged that it is expected a man will be able to impart to the saloon a rolling motion in relation to the ship precisely the reverse of that which the ship receives. The engines, it is anticipated, will drive the ship at a speed exceeding 20 miles an hour.

ATTACHING SLATES.—A Boston architect says he has been in the habit for many years of bedding his roofing slates in hydraulic cement, instead of having them nailed on dry in the usual way, which leaves them subject to be rattled by the wind and to be broken by any accidental pressure. The cement soon sets and hardens, so that the roof becomes like a solid wall. The extra cost is ten or fifteen per cent, and he thinks it good economy, considering only its permanency and the saving in repairs; but besides this, it affords great safety against fire, for slate laid in the usual way will not protect the wood underneath from the heat of a fire at a short distance.

GEARS FOR CHANGING DIRECTION OF MOTION.

OUR engraving shows a form of gears for changing the



direction of motion, somewhat rare in use, but effective for many purposes.

VERTICAL GRIST-MILLS.

THE idea of placing the grinding stones on horizontal spindles, like common pulleys, is very old, but has never come into much use except for small mills, where coarse grinding and speed are wanted. It does not follow, however, that this plan can not be successfully applied to the finer kinds of flouring. According to Leffel's *News*, "a vertical mill of somewhat novel character has lately been introduced, in which two or more pairs of millstones are combined on one horizontal shaft, or on sections of a shaft, and driven by one belt or gear, the power being applied directly to the shaft. No intermediate shafting is used, and the cost and care of a number of pulleys, belts, gears, etc., is thus in many cases saved by the adoption of such mill. Furthermore, the millstones are faced and furrowed on both sides instead of only one, and combined in groups of three or more. In a group of three, the centre stone is fast to, and revolves with, the shaft, with a stationary or bed stone adjusted on each side of it, making two mills out of three stones; and each of the three stones being interchangeable, there is afforded, practical-

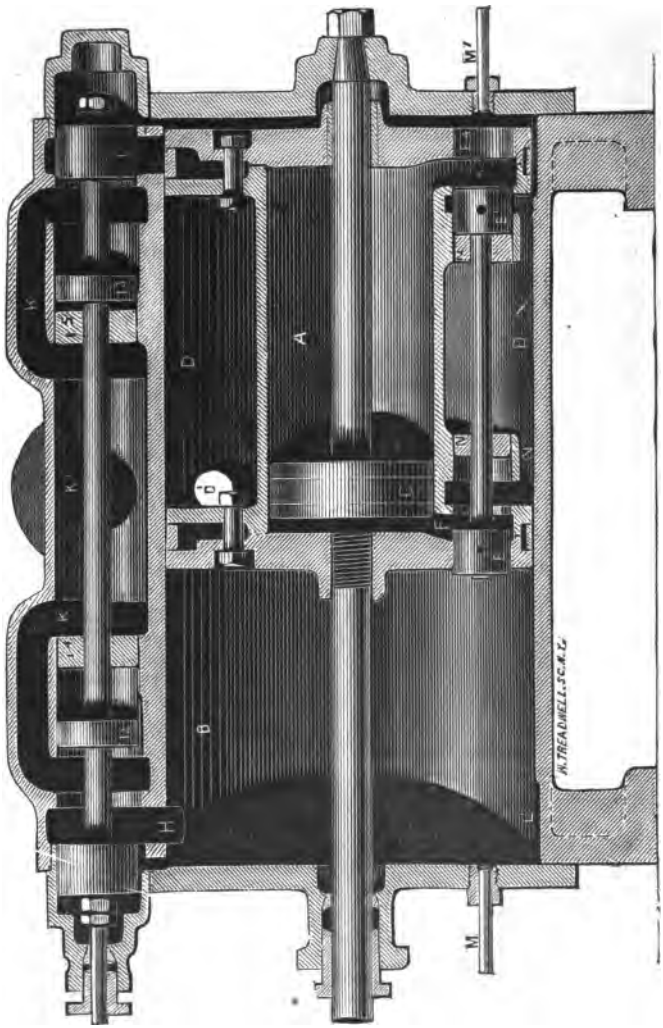
ly, the grinding surface of three mills. As each stone is double-faced, any one of the three may be taken out to be sharpened at any time and another put in its place, so that the mill can be kept running without interruption. If one more stone be added to a group of three, there will be three mills with four stones, or five stones will make four mills; and so on to any desired number, all being driven by one belt or gear, and occupying only one foot in length of shaft to each mill. It is argued in behalf of this arrangement that a group of five stones, making four mills, will occupy only the space usually taken by one mill, and that the four have only two bearings to care for, while the step so troublesome to millers is entirely done away with.

There is evidently a very material saving of room in this arrangement, whatever may be its other merits or defects; and it must also be admitted that any device which enables the miller to simplify his machinery, dispense with complicated and costly gearing, and bring the work in close proximity to the power, is so far a very valuable gain.

DETERMINATION OF THE HEAT OF COMBUSTION OF EXPLOSIVES.

MM. ROUX and SARRAN communicate to *Les Mondes* the following description of the mode of determination and results obtained, in testing the heat disengaged by the combustion of various kinds of gunpowder. The deflagration was produced in cylindrical cast-iron shells of 0.9 inch in thickness and of an interior capacity of from 16 to 17 cubic inches. These bombs were closed by a bronze screw plug through which passed an isolated wire, which conducted a current sufficient to heat a thinner wire within to redness and thus inflame the charge. They were placed in a copper vessel 4.5 feet in diameter, 5.1 feet in height, and containing about 4 pounds of water. The temperature of the bath was determined by the end of a thermometer graduated to tenths of a degree, with reading to hundredths. The water was first brought to a temperature equal to that of the surrounding atmosphere, the explosion caused, and then the difference in warmth noted. The following results were obtained:

	Sulphur.	Saltpetre.	Charcoal.	Units of heat per 2.2 lbs. of powder.	Weight of gas per 2.2 lbs.
Fine sporting powder,	10.0	78	12.0	807.3	0.337
Cannon "	12.5	75	12.5	752.9	0.412
Musket "	10.5	74	15.5	730.8	0.414
Ordinary com. "	13.0	72	15.0	694.2	0.446
" blasting "	20.0	62	18.0	572.2	0.499



FIELD & COTTON'S NEW COMPOUND STEAM-ENGINE.

NEW COMPOUND ENGINE.

OUR illustration shows the new direct expansive compound engine of Messrs. Edward Field and F. M. Cotton, of Chandos Chambers, Adelphi, London, England; the illustration from *Engineering*. The arrangement consists essentially of a high-pressure cylinder placed within the low-pressure cylinder, and moving backward and forward upon a fixed piston; the annular space around this high-pressure cylinder is always filled with steam direct from the boiler, which passes into the cylinder through the ports on the lower side, the admission being regulated by the piston-valves shown in the engraving. By means of these valves, also, the steam from the smaller cylinder enters the low-pressure cylinder while at the end of each stroke a small quantity of steam passes from the annular reservoir into the low-pressure cylinder, to serve as a cushion and to move the valves. Piston-valves, on the top of the low pressure cylinder, regulate the communication between it and the exhaust.

In the section, A is the high-pressure cylinder, the flange and covers of which serve as a piston to the low-pressure cylinder B; the fixed piston is shown at C', and D is the annular high-pressure steam-chamber or reservoir in direct communication with the boiler by the pipe D', surrounding the cylinder A, and moving with it. The piston-valves belonging to this cylinder are shown at E E', and are connected by a spindle I^4 I^5. They work in cylindrical passages bored out of the lugs N N', and cushions M are introduced as shown to receive the blow from the valves at the end of each stroke. The valves for opening and closing the exhaust of the low-pressure cylinder are shown at I I'; they are also connected by a spindle, and cushions similar to those just mentioned are provided at I^4 I^5, for the cushioned valves I^3 I^3 to strike against. The exhaust-opening is shown at K'. At each end of the low-pressure cylinder is formed a small grove L and L', which admits steam from the annular chamber into the low-pressure cylinder at the end of each stroke, for the purpose of throwing over the valves E E', and of forming a cushion for the moving high-pressure cylinder. Small spindles I, M, and M' are provided, the former at the end of the exhaust-valve chest, and the latter at each end of the low-pressure cylinder, in a line with the centre of the valves E E', in order to move the latter if necessary.

Taking the position of the high-pressure cylinder at the end of its stroke, as shown in the section, it will be seen that the valves E E' are thrown forward, so that steam

from the annular chamber is admitted through the port F to the forward side of the fixed piston C; at the same time the motion of the valve E' has opened the exhaust part of the cylinder A, the steam from which passes into the low-pressure cylinder. But before this takes place, it is necessary to remove the valves E E', which is effected as follows: The cylinder A, in coming to the end of its stroke, passes over the small grooves L before mentioned, and admits steam from the annular chamber D, which passing into the small space in the low-pressure cylinder, behind the end of the high-pressure cylinder, acts at once upon the back of the valve I', which it throws over, opening the communication between the low-pressure cylinder and the exhaust, and also upon the valves E E', which are moved into the position shown in the section, Fig. 1. The steam from the chamber then passing into the cylinder A, and that from the same cylinder being exhausted into B, both act simultaneously in the same direction.

The arrangement just described and illustrated is adapted especially for working pumps direct, and steam is admitted into the high-pressure cylinder during the whole of its stroke. By a modification, however, the engine may be connected to a crank-shaft, and any desired degree of expansion obtained. The proportion between the cylinders is five to one.

AMERICAN CENTENNIAL EXHIBITION, 1876.

THE committee have adopted the general plan of Vaux & Radford, of New-York, for the building known as the "pavilion plan," which contemplates a building which will be mainly a succession of immense cast-iron arches, the whole forming a rectangular elevation which can be enlarged in any direction to an almost indefinite extent.

The principal part of the building covered by the pavilions becomes one spacious hall 408 feet wide and 2040 feet long, with a transept 408 feet wide and 952 feet long. The vistas, of course, extend 952 and 2040 feet in length. The building is capable of both central and intermediate points of emphasis, direct lines of transit throughout its entire length and breadth, diagonal lines of communication, if deemed necessary, and especially an entire relief from any appearance of contraction, because the visitor will always be in an apartment 140 feet wide, that opens immediately into other apartments of the same width.

Features suggested by the plan of Sims & Brother, of Philadelphia, are to be introduced in constructing distinct parts of the building. The material will be iron and brick.

UTILIZING EXHAUST-STEAM.

WILLIAM BURDON, of Brooklyn, N. Y., proposes to combine a steam-engine, a steam vacuum-pump, and a water-wheel, in such a manner that the exhaust-steam from the engine shall operate the vacuum-pump, and the latter raise water to a sufficient head to run a turbine or other water-wheel to act as an auxiliary to the engine.

CANAL-BOAT PROPULSION.

ONE of the most novel of the plans proposed to solve the question of steam canal navigation is that suggested by J. P. Tice, of New-York, which consists in running a light traction-engine, without boiler, on the tow-path, propelled by steam generated in a boiler on board the boat, which is to be supplied to the engine through the medium of a flexible tube, the latter also serving as a tow-line by which the boat is drawn by the engine. The engine is to be made very light, so as to be readily handled by the driver; but, to insure the necessary traction, it is to be ballasted with water proportioned to the load it is to draw.

A COMPOUND LOCOMOTIVE.

AN ingenious member of the Manchester Scientific and Mechanical Society proposes to apply the compound principle to locomotives. This is how he sets about it, says the *English Mechanic*. He would use steam of 250 lbs. on the square inch to work the small cylinder, and expand this steam into a supplementary boiler bearing a pressure of 60 or 65 lbs. to the square inch, so as to have a surplus of effective pressure of 180 lbs. or 190 lbs. in the small cylinder, or about 60 or 65 lbs. in the larger one. The principal alterations proposed are in the boiler. In adapting his plan to a locomotive of the medium size, he would make the boiler 2 feet longer than at present, and divide it into two distinct parts, the part containing the furnace or fire-box to be 2 feet shorter than at present, so as to have the supplementary boiler 4 feet longer, both being equal in diameter, and equal in number, size, and position of tubes, the two parts of the boiler being firmly bolted together, and so arranged that the tubes of one are in a line with the other, so that the hot air and flame may pass freely through from one to the other. An important advantage claimed by the plan is that the driver of the locomotive will be enabled to start his engine with the full power of steam in both cylinders at once, which he could not do if compounded in the usual way. Although this plan will require extra outlay, there will be a con-

siderable saving in fuel, which, with other advantages, it is claimed, will more than compensate for the extra cost. We are not surprised to hear that discussion followed the reading of the paper, in which the feasibility of the plan was generally condemned. Ultimately, however, the discussion was adjourned, in order that the inventor might give further information on the subject.

STEEL CAR-WHEELS.

AN improvement by Hadfield, of Sheffield, England, and described in *Iron*, is as follows:

An ordinary rolled crucible of Bessemer steel, iron, or other tire, is heated as hot as possible (without burning) in a suitable furnace, and then placed in a casting-box, the nave being first placed in the centre and moulded thereto in the ordinary way. Molten crucible steel, or iron, or other metal, is then poured therein, whereby it becomes united together in one solid or hollow homogeneous weldless wheel, thus obtaining a combined wheel of great strength, elasticity, and tenacity, free from the defects and liability to breakage of those in ordinary use. The wheel is afterward annealed if required.

For wheels of a similar construction to those at present in ordinary use upon railways, the tire is first suitably heated and placed in the casting-box, and then the nave placed in the centre. Pieces of crucible or Bessemer steel, or wrought iron, of the necessary thickness, cut into suitable lengths to form the arms or spokes, are arranged around and retained in their position by moulding in the ordinary manner. Molten steel, iron, or metal is then poured in or otherwise introduced, until they become united into and form one solid homogeneous weldless steel or metal wheel. These wheels are said to be peculiarly free from jarring and concussion, as well as more economical than ordinary wheels, and they are not so liable to sudden expansion or contraction. The absence of complicated tire fastenings is another very advantageous feature.

WIRE CONCRETE.

MR. PHILIP BRANNON, says *Hardware, Metals, and Machinery*, has devised a system of wire concrete which consists of a sustaining metallic framework or skeleton, upon which wires are strained, the whole being inclosed in the concreted materials forming the body of the structure. By this arrangement, not only are the walls and floors of a building run up in concrete, but the doors, shelves, and other fittings are formed of the same material. The

strains on the building are thus equally distributed, and a fireproof construction, it is stated, insured.

The system is considered advantageous for the building of piers and sea-walls, and is applied to breakwaters by lining bags of wire with concrete and filling them with sand. These are placed in position before the concrete has perfectly set, and are well rammed down together.

THE EFFECT OF FLAT WHEELS ON RAILROAD TRACKS.

A CORRESPONDENT of the *Railroad Gazette* considers that the surface or tread of car-wheels should be tested by the use of a hammer, and when blisters are found, the wheels should be rejected, because the blistered spot soon becomes flat, and not only damages the rail, but shakes the whole car so as soon to do as much damage to the car as the price of a good wheel. It is believed that these flat wheels making 200 revolutions per minute, with the flat spots making steam-hammer blows on the track at each revolution, are a frequent cause of broken rails.

A PNEUMATIC SEWING-MACHINE.

A SEWING-MACHINE motor, invented in England by Joseph E. Holmes, consists of a sewing-machine having, below the table, a train of gear-wheels and an air-pump, operated by a crank, the pump being used to exhaust the air from a cylinder underneath a piston which traverses the cylinder. The exhaustion of the air causes the piston to descend and drive the sewing-machine. If a vacuum equal to 14 lbs. to the inch can be obtained, the piston being 9 inches in diameter, the pneumatic pressure on the piston will be 890 lbs., equal to a weight of that amount falling say three feet, the height of the sewing-machine table under which the piston is placed.

This device strikes us as a rather complicated method of applying and storing the power exerted by the individual in turning the crank. The coil-spring would be simpler and cheaper. We have seen sewing-machines driven by springs that operated well.

NEW PLAN OF REMOVING SAND-BARS.

A METHOD of removing sand-bars from rivers, invented and patented by Alfred Garnham, of St. Louis, Mo., consists in anchoring a cable under water, and providing the cable with angular arms, so arranged that the force of the stream will actuate the arms, make them revolve and beat up the sand, which is swept away as fast as loosened by the current.

ON THE EFFECT WHICH THE DEPTH OF IMMERSION HAS ON THE RESISTANCE OF THE SCREW.

By Professor Osborne Reynolds, M.A.—It has been stated by several writers on the screw-propeller, and is, I think, generally supposed, that the resistance of the water to a screw increases with the depth of immersion below the surface. Improvements have been made by Mr. Rennie and Mr. Maudslay, which appear to prove this; but I do not think that any theoretical reason has ever been given. Now, this idea is so contrary to our fundamental notions of hydraulics that I thought it would be worth while to make experiments. These experiments show us that there is not any increase beyond a certain point, and that this point is that at which the screw ceases to break the surface and get air. In a paper read before the Institution of Naval Architects, I explained how the air getting down to the screw is the cause of racing. In the same way, it may be shown that it was the air that was the cause of the diminished resistance near the surface, found by Mr. Rennie and Mr. Maudslay.

The conclusion is that, when a screw is once fairly down below the surface, depth of immersion is of no advantage. Experiments on the effect of immersion on the resistance of screw-propeller were made June 8th, 1873. The screw was 2 inches in diameter, driven by a spring which, when wound up, caused it to make 240 revolutions. The resistance at the different depths was measured by the time taken for the spring to run down.

NEW AND REMARKABLE CANNON,

The German journals announce that the recent trials of new guns on iron-plated targets, which took place at Tegel, near Berlin, fully satisfied all expectations. The shot from the 11-inch ring cast-steel gun penetrated an iron plate 12 inches thick; that from the 10-inch gun of the same pattern an iron plate of 11 inches; and there was force to spare in both cases. At Krupp's works, at Essen, trials have been made with the newly constructed 30½° centimeters (12-inch) ring cast-steel gun, and the result justifies the belief that this gun will pierce 14 and perhaps 15 inches of armor. Thus, the strongest iron-clad now existing, her British Majesty's ship Devastation, which is provided with an armor of 14 inches, will no longer be invulnerable, if opposed to such guns.

The liability of safety-valves to stick, in consequence of corrosion, is obviated by nickel-plating both the valve and the seat.

ASBESTOS PISTON PACKING.

FROM an address, by J. G. Gibbon, before the London Association of Foreman Engineeers, it appears that the name of this indestructible compound is derived from the Greek word ασβεστος, which, translated, literally means unburnable—a title which is justly earned by this extraordinary substance. Asbestos is a mineral; it is found in nearly every part of the world, and occurs in distinct veins and seams, usually in the serpentine formation of rocks. In order to procure it, it is necessary to mine in regular form, and to work the seams by blasting and tunneling. The manufacture of asbestos steam packing is at once a simple and beautiful process. The raw material is brought to the manufactory in considerable quantities from different parts of the world. It comes in sacks, and resembles most closely chips and blocks of wood, although of a beautifully white color. The fragments are picked apart and reduced to a fibrous condition like jute, or flax, or cotton. The material once properly opened up, it is, by means of simple and ingenious machinery, formed into packing of the usual market sizes. The machines themselves are as easily attended to as are weaving-looms. As to what has been really accomplished by this packing, I have no direct evidence to offer; but from the sample I have here, I think it does not seem to possess a good fibre; and that when the flaxen twine which binds it is cut, it will become very much like cotton-waste. I am inclined to think, therefore, that when the glands get heated and the flaxen twine is cut through, it will blow out like charred flax, and have no elasticity. However, I am here to be corrected in my opinion, if I form a wrong one, by those who can offer contradictory, evidence. A large screw-steamer lying in the West-London Docks has just replaced the whole of its packing by asbestos.

CORK JACKETS FOR STEAM-BOILERS—M. Chevallier, a French engineer, has adopted cork for the jacketing of boilers and other parts of machinery. Cork is known to be an excellent non-conductor of heat, and these cork jackets are said to diminish the outward radiation by 15° C. The cork is cut in the form of staves, and these are united together by tongues, as in the case of flooring-boards, so that the lines of junction are protected, while the cork staves are easily removed when the necessity occurs. Portions of one of these jackets which had been on a boiler at work fifteen months, were lately exhibited before the Paris Society for the Encouragement of the Arts, and found unaffected by the heat of the boiler.

A TRAP TO CATCH LIONS.

In Algeria, there is annually a great loss of life and property, by the depredations of lions. The loss of property is estimated at $50,000 a year. The inhabitants cut away the forests as a means of protection against the wild beasts. M. Cheret devotes himself wholly to their extermination. As an assisting means in this his life-work, he has invented a lion-trap made as follows:

The frame and bars are of iron. It is 10 feet long, 6 feet 6 inches wide, and the same in height. Mounted on three cast-iron wheels of small diameter, it can be moved on difficult ground. The upper part opens with folding-doors, like a wardrobe, which close of themselves at the slightest shock given to springs of steel. Catches retain the lids as they fall, and imprison the animal as soon as he touches the bottom of the trap. The plan is to place this trap, properly baited, on the ground frequented by the wild animals, and then, when the game is caught, to wheel the machine away to some menagerie prepared for the purpose.

IRON-CLAD VESSELS.

The invention of iron plates to protect vessels is far from being of as recent date as is generally supposed, During the 12th century, the Normans covered their ships. from the water-line up, with an iron casing, terminating in a ram on the bow. Still earlier, they had adopted a system of protecting the upper works with metal shields. In 1534, Peter of Arragon ordered his ships to be iron-plated, in order to protect them from the burning missiles then in common use. In 1530, the squadron of Andrea Doria contained a vessel built by the Knights of St. John, which was armored with several thicknesses of iron. At the battle of Lepanto, several ships protected their batteries with bars of iron. For two centuries, no progress seems to have been made. In 1782, at the siege of Gibraltar, an engineer officer constructed six ships, which were the types of the modern iron-clads. They were covered with an armor of hard wood, leather, and bar-iron, It is said that they resisted the fire of the forts for a long period, but were finally sunk by red-hot shot.

METALLIC CARTRIDGES.

W. H. Tooth, of Brixton, England, proposes the use of metallic cartridges, having the shells made of some easily fusible metal, so that the heat generated by the explosion will melt the case of the cartridge, and allow it to be blown out of the muzzle instead of requiring a special device to extract it from the breech.

GLYCERINE IN BOILERS.

AT the last meeting of the Society of Civil Engineers, Mr. Asselin recommended the use of glycerine to prevent boiler incrustations. The theory is, that glycerine, soluble in water in every proportion, increases the insolubility of combinations of lime, and especially of the sulphate; it appears, beside, to form with these combinations soluble compounds. When the quantity of lime becomes so great that it can no longer be dissolved, nor form with the glycerine soluble combinations, it is deposited in a gelatinous substance, which never adheres to the surface of the iron plates. Moreover, the gelatinous substances thus formed are not carried with the steam into the cylinder of the engine.

Mr. Asselin advises the employment of one pound of glycerine for every 300 or 400 lbs. of coal burned. This rule is by no means absolute, and must be corrected by experiment. But it appears reasonable to proportion the quantity of anti-incrustating fluid to the fuel consumed, and not to the power developed, or the area of heating surfaces. The glycerine is placed into the boilers in such a quantity, that sufficient for fifteen days' supply is introduced at a time. From trials made with boilers fed with bad water, it was proved that the glycerine combined with all the salts, and left the plates perfectly clean. The objection has been raised against this mode that the glycerine may produce priming, but this objection has not been proved valid, and M. Asselin replies that insoluble bodies can only produce such an effect, and that it is not to be feared with glycerine. (106)

EFFECTS OF AIR UPON THE CONDENSATION OF STEAM.

THE conclusions which Professor Osborne Reynolds draws from a series of experiments are as follows:

1. That a small quantity of air in steam does very much retard its condensation upon a cold surface; that, in fact, there is no limit to the rate at which pure steam will condense but the power of the surface to carry off the heat.

2. That the rate of condensation diminishes rapidly, and nearly uniformly as the pressure of air increases from two to ten per cent that of the steam, and then less and less rapidly until thirty per cent is reached, after which the rate of condensation remains nearly constant.

4. That in consequence of this effect of air the necessary size of a surface condenser for a steam-engine increases very rapidly with the quantity of air allowed to be present within it.

5. That by mixing air with the steam before it is used, the condensation at the surface of a cylinder may be greatly diminished, and consequently the efficiency of the engine increased.

6. That the maximum effect, or nearly so, will be obtained when the pressure of the air is one tenth that of the steam, or when about two cubic feet of air, at the pressure of the atmosphere and the temperature 60° F., are mixed with each pound of steam.

A MINIATURE STEAM-BOILER EXPLOSION.

BY GRAEGER.—A solution from which a quantity of alcohol had been distilled in a glass flask, and containing about 5 per cent sugar and as much gum, was allowed to cool again. On heating once more to boiling over a spirit-lamp, the flask resting on wire gauze, the author noticed that the solution was an unusually long time before it began to boil, and just as he was about to remove the flask an explosion occurred, destroying some glass apparatus near at hand, but only damaging the flask to the extent of a small hole pierced in the neck. The accident was attributed to the fact that all air had been removed from the solution by the previous boiling, and that, in heating up again the second time, the temperature of the solution had been raised considerably above the boiling-point, when a position of unstable equilibrium was attained which the smallest shock was able to upset. It is recommended that solutions freed from air by previous ebullition be always shaken up well, to take up a little air, before boiling again.

INCRUSTATION OF ENGINE-BOILERS.

A COMMITTEE of the Master Mechanics' Association appointed to investigate the subject of boiler incrustation, report that none of the patent devices designed to prevent the difficulty are effectual, and that the only sure precaution against incrustation is to be found in the use of pure water. The boilers of ocean steamers are injured by the hydrochloric acid found in the distilled sea-water which is employed. For locomotives, the committee suggest the use of rain-water only; and they furnish figures to show that it would in the long run be economical for a railroad company to construct reservoirs at intervals along their roads. They say that the annual cost of repairs to a locomotive made necessary by the use of impure water is about seven hundred and fifty dollars. In the absence of reservoirs of rain-water, the committee recommend the use of surface water, or that from rivers, creeks, or ponds, as being found less objectionable for use in boilers than the water of springs.

A NEW LIFE-RAFT.

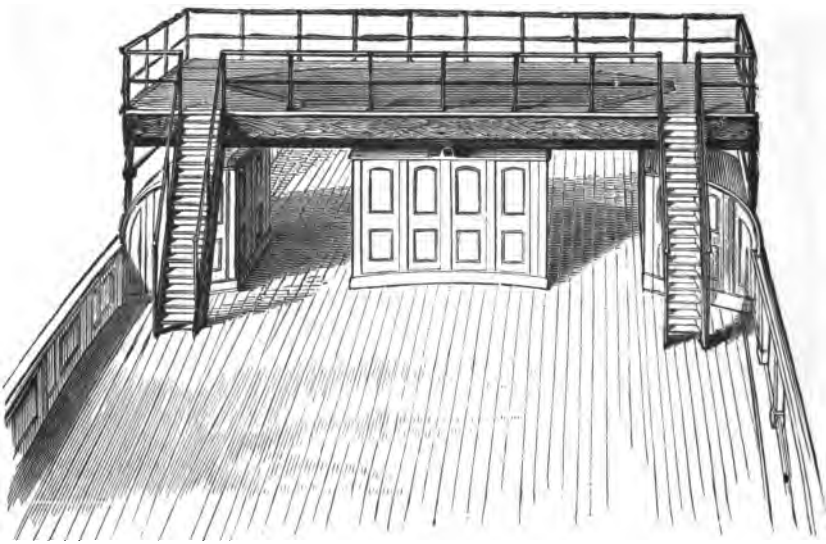
OFFICIAL inquiry has shown that first-class passenger ships can not carry a sufficient number of boats, in case of being compelled to abandon the vessel at sea, to insure the safety of much more than half the persons on board, supposing a full complement of passengers and crew, even

THE LIFE-RAFT AT SEA.

under the most favorable conditions of weather. In tempestuous weather, the proportion would be diminished, and in either case it would depend on the number of boats that could be successfully launched. The sad records of shipwreck show how little reliance can be placed on this means of saving life. How frequently boat after boat is swamped in launching, or capsized by overcrowding by the rush of panic-striken people!

As a substitute for boats, large life-rafts have been constructed, which can be carried on board ship more easily than boats, can not be swamped in launching, nor capsized in any sea. Many of our American steam ship lines

now carry these rafts. They are placed on board all the steamers running from New-York to Havana. An English gentleman, Mr. Henry Christie, has also invented a raft which promises well for the safety of the shipwrecked, engravings of which appear on this page. This raft can be made to any size, but the depth need be no more than from nine to fifteen inches. It is designed to form a bridge, the roof of a deck-house, or a section of a bulwark. There are thirty-six compartments made of zinc,



THE LIFE-RAFT BRIDGE IN POSITION ON BOARD SHIP.

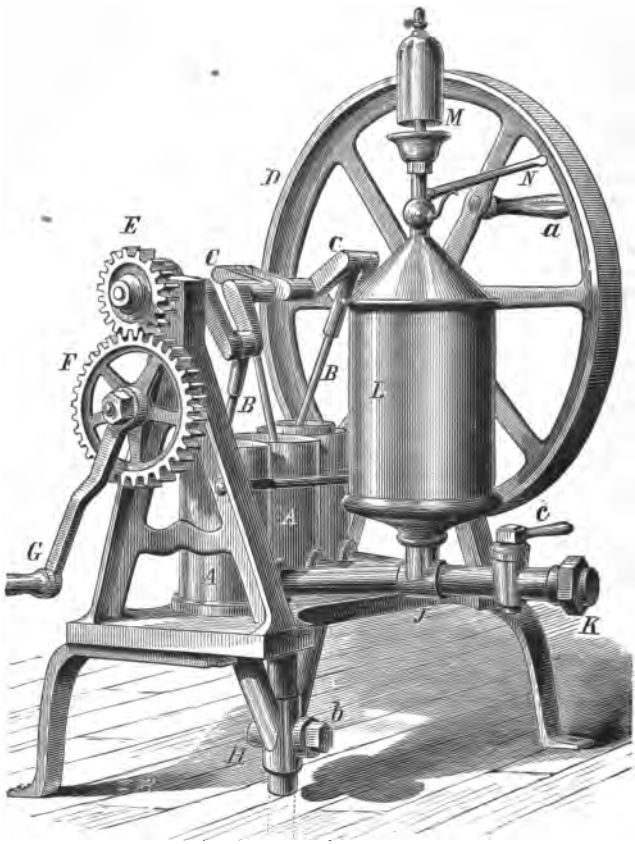
some of which would contain provisions and water, while the remainder would add to the buoyancy of the raft. There is space for masts, sails, oars, and other requisites. Certain sections of the deck of the raft are heavily hinged so as to form a bulwark, affording shelter on all sides. This space would naturally be reserved for women and children. The first engraving shows the raft laid on a bridge, the flooring of which being balanced on an axle, one man can by drawing a bolt allow it to drop down to the

bulwark of the ship, from whence it flies off on rollers into the sea. The second engraving shows the raft in the water—a strong, serviceable craft that will live through seas in which ordinary boats would be swamped. The raft, even if not launched in time, will float away as the ship sinks, and can not be capsized by overcrowding or by the heaviest sea. To make doubly sure, however, the latter contingency is provided against, both sides of the raft being precisely alike. (52)

CLEANING GUNS WITH PETROLEUM.

GREASING a weapon with fats and oils does not entirely protect it from rust; the so-called drying oils get gummy and resinous, while the non-drying oils become rancid; and by exposure to the action of the atmosphere, acids are formed, and these attack the iron. These are some of the reasons why petroleum is to be preferred for this purpose. Petroleum is as great an enemy to water as are the fatty oils; and hence when a gun-barrel is covered with a film of petroleum, it keeps the water away from the metal which forms the barrel; the water which rests upon this film of petroleum evaporates, but the oil does not, and hence no rust can be formed. It is very essential, however, that the petroleum or kerosene employed be perfectly pure, for impure oil, such as is often met with in commerce, attacks the metal. Care must also be taken not to allow it to come in contact with the polished stock.

The gun is cleaned as follows: Each rifleman carries a tin flask of pure kerosene and a round brush, of stiff hogs' bristles, which fits the barrel of the gun. The brush is screwed to the ramrod. The gunner also carries some dry hemp or tow. When about to clean a gun, some tow is wrapped about the rod and enough petroleum poured upon it to thoroughly moisten it; it is then pushed in a rotary manner through the barrel and back a dozen times, and the hemp taken out and unrolled, and the upper and lower ends of the barrel rubbed with the clean part, after which it is thrown away. This removes the coarser portion of the dirt. The brush is then moistened thoroughly with petroleum and twisted into the barrel, running it back and forth at least a dozen times, thus loosening the dirt that is more firmly attached to it. The first operation is now repeated, except that the hemp or tow on the rod is left dry, and the rubbing with this must be continued in all directions as long as it comes out soiled. The use of wire brushes is objectionable for cleaning guns, as the numerous little steel points cut into the tube. Only soft tow, hemp, woolen rags, or the like, should be used, as the petroleum dissolves off the dirt sufficiently.



COMBINED SHIP'S PUMP, FIRE-ENGINE, ALARM-WHISTLE, AND TELEGRAPH.

THERE is no worthier aim for inventors than the construction of apparatus to increase the safety of life on the sea. The apparatus represented in our engraving has this aim, and, moreover, is distinguished for the diversity of its workings. It can be used as alarm-signal in fog, as telegraph, as pump for draining off water from the bottom of the ship, for washing and cleaning the deck, and, finally, as a fire-engine.

The frame supports three pump-cylinders A, whose pis-

tons are connected by rods B with the common crank-shaft C. The cranks are arranged under angles of 120° on the shaft. The latter is provided at one end with a fly-wheel D, which is turned by manual power, applied to the crank *a*. The opposite end of the crank-shaft has a spur-wheel E, which receives motion from a toothed wheel F, operated by crank G. A slow motion may be given to the pumps by turning the handle *a*. But a quicker motion is obtained when the machine is driven by the crank G.

The inlet pipe to the three pumps join into one at H, which extends below decks to the hold, or branches to the sea as desired. At *b* is a two-way cock, which, according to the direction in which it is turned, admits air to the pumps and closes the pipe H, or shuts off the ingress of air, and opens pipe H, so that the pumps will draw water through H from the hold of the vessel or sea.

The lateral tubes communicate at J with the air-chamber L, at the top of which the alarm-whistle M is placed. The whistle is operated by the lever N, by pressing it down. The water-discharge pipe K is opened or closed by cock *c*. A hose-pipe may be attached to K, and the discharge of water regulated by turning *c*.

Should an accident happen to one of the cylinders A, it can be taken out and repaired without the others being disturbed.

For the ordinary pilot signals, one man can use the machine by turning the wheel D with one hand, and with the other managing the lever N. For signals which have a piercing tone, or a quick succession of whistles, the pumps can be put into motion by means of the crank G. The signals are similar to the telegraph alphabet of the Morse apparatus, and consist of a succession of long and short tones. A short and a medium tone, for example, signifies the letter A; a shorter tone, E; two short tones, I, four short, H; a longer tone, L, etc. The signal of distress consists of a succession of short, quick-following whistles.

In a similar manner, the points of the compass are signalized. A tone of medium length signifies, for example, North, and thus East, South, and West are designated by 2, 3, and 4 tones. Between every one of these cardinal points, there are seven points which are signalized by 1, 2, 3, and 4 short tones, after notice of the cardinal points; for example, north-west would be a medium tone followed by four short tones. In such a manner, the course of a ship is signalized in the distance, and prevents the possibility of a collision. It is asserted that the sound of the air-whistle is sharper, and audible at a greater distance than that of the steam-whistle, because the tones of

the latter are affected by the condensed water. A pressure of air of 35 lbs. to the inch serves for as intense tones as those of a steam-whistle which is put under the pressure of 70 lbs. The Haskell apparatus is especially useful for sailing-vessels where steam is not available. (36)

NEW RUSSIAN CIRCULAR WAR-SHIPS.

THE idea of circular vessels is not absolutely new. Probably the earliest practical suggestion was that of Mr. T. R. Timby, of Worcester, Mass., who, in 1843, filed in a working model of a revolving ship, together with specifications, in the Patent-Office at Washington. His plan embraced circular ships and revolving iron-clad forts and turrets, which have since come into use.

Admiral Popoff, of the Russian Navy, has also adopted the idea, and quite recently two vessels, the Kiew and the Novogorod, have been successfully launched at Nikolaief.

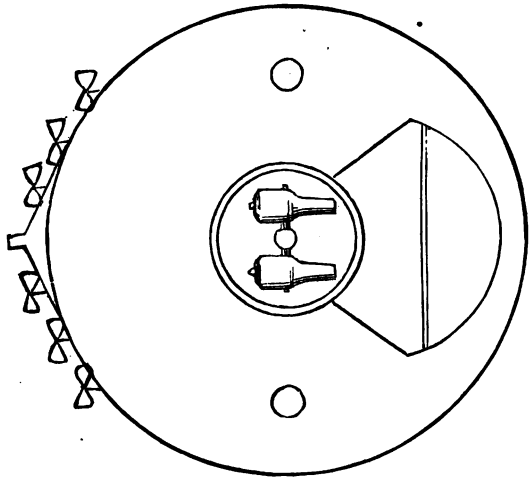
We lay before our readers, in the accompanying engravings, sectional and plan views of these curious ships, from the pages of *La Nature*. Each vessel is 99.2 feet in diameter and constructed of iron, planked with wood and sheathed with copper. The draught of water is 12.1 feet, and the spar deck is 2.1 feet above the water-line. The displacement is 2783 tons. The bottom is perfectly flat, and the sides are vertical, with an overhang aft, sheltering the rudder. In order to insure stability, twelve keels are affixed, each about three inches in depth.

At the centre of the ship is a turret, 29 feet 6 inches in diameter and 7 feet high, containing two 11-ton steel guns, (probably eight-inch bores,) breech-loading and mounted *en barbette*. The turret has a hollow axis which serves as an ammunition-scuttle, and on which pivot the supports of the guns, so that the latter can be pointed over an angle of from 30° to 35° with the fore and aft direction of the ship. The rest of the armament consists of torpedo arrangements.

The lower portion of the hull is double, and there is a space of about 2.9 feet between the shells. The lower plating is .62 inch in thickness and the upper .23 inch. The hold is divided into a large number of water-tight compartments. Parallel to the upper deck and about six feet below is a second deck, both being united to the lower shell by bulkheads.

Forward of the turret is a light superstructure serving as a protection against the sea, and as quarters for captain and other officers, eleven persons in all. The second deck comprises a forecastle for the crew of ninety men, and furthest aft the coal-bunkers and boilers, each of the latter

having a separate smoke-stack. Amidships are other officers' quarters and a powder-scuttle. There are six eighty horse-power engines, built on the Woolf system, each driving an independent screw. Machines and boilers toge-

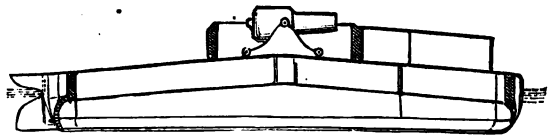


ther cost $222,000, about. Below the forecastle are storerooms; and under the officers' quarters, the powder-magazine and shot-lockers. Two steering wheels are also on the second deck.

The armor consists of two streaks of plating about 3 feet broad: the upper layer is 9.1 inches thick, and is backed by solid teak 6 inches through; the lower skin is 6 inches, with a backing of 9 inches. The turret is similarly constructed, with the exception of the plates having a uniform thickness of 9 inches. At a distance of about 2 feet inside the walls of the ship is a water-tight bulkhead formed by 7-inch plating, dividing the battery into two parts, so that in case water should enter one of the exterior compartments, the vessel would still float.

The trial-trip of the Novogorod was recently made at Nikolaief, in presence of the Grand Duke Constantine of Russia. Although the ship was hardly completed, or entirely ready for sea, it is stated that, with a steam pressure of 5.2 pounds, and a vacuum of 21.4 inches, with 62 revolutions, a speed of 6 knots per hour was obtained. The ship proved herself an excellent sea-boat, obeying her helm readily, and turning almost squarely on her heel

when the engines on either side were stopped or their speed slackened. With the port engines going ahead, and the starboard engines backing, it is stated that she went about the first time in two minutes, and on a second trial



in one minute and nineteen seconds, with hardly changing her place. On reversing both machines, the ship stopped in a few seconds and turned in the opposite direction, also without altering her position.

STEAM CANAL-BOATS ON THE ERIE CANAL.

THE trial of steam canal-boats on the Erie canal, in competition for the $100,000 prize, came off between Syracuse and Utica, N. Y., on October 15th and 16th, 1873.

The members of the State Commission present at the trial were Van R. Richmond, George Geddes, John D. Fay, E. S. Prosser, Daniel Crouse, W. S. Nelson, and George W. Chapman; also D. M. Greene, engineer in charge, and H. A. Petrie, Secretary of the Commission.

The boats were required to be able to carry 200 tons of cargo, besides their motive power, and to make an average of three miles an hour. But none of the boats made this time, and none can claim the reward.

The detentions of the various boats along the way were very great.

The Syracuse *Journal* gives the following conclusions, drawn from remarks made by several of the commissioners:

1. That it is quite impossible to invent any machinery that will propel a boat carrying two hundred tons at a less cost than when moved by horse-power, with the present dimensions of the canal.

2. That boats, as now constructed, are too large for the capacity of the canal, their progress being retarded by natural and well-known laws relating to space for the displacement of water.

3. That as the law requires that inventions shall be of a character making them practical for superseding horse-power, an award is not likely to follow the test.

4. The law requires a speed of at least three miles an hour; and as none of the boats made that time, an award can not be legally made.

IRON SHIP-BUILDING.

MESSRS. HOLMES & BOWRON, of Philadelphia, suggest the dispensing with the usual T or angle-iron transverse ribs, and forming the entire shell of the vessel of plates having flanges formed on two edges. These flanges should be riveted or welded together when in place, and thus united, form strong ribs, which, it is claimed, will make a more substantial vessel than can be formed by the old plan, without additional metal. Where extra strength is required, ribs may be inserted between, or attached to the flanges.

ROPE TRAMWAYS.

ROPE tramways, on Hodgson's and Baron Duecker's systems, are getting more and more into use with good results. At the fortifications of Metz, between the village of Sablons and Fort Quenlen, such a line has been established since October last year, for the transport of earth used in constructing the ramparts and breastworks. This line is 2000 metres in length, and passes over two high-roads, three by-ways, the Seille River, one hill, and three valleys, and reaches the fort with an elevation of 45 metres above the other end. The line is double and is worked by an endless rope, 20 loaded cars, of 5 cwt. each, being drawn upward, and at the same time 20 empty ones coming down. The wire-ropes are 25 to 30 millimetres in diameter, and made by Messrs. Guillaume & Velten, of Cologne, and they are supported at intervals of from 25 to 30 metres. The line is worked by a 12 horse-power road-engine, and gives complete satisfaction. Another line has existed for nearly two years near Eisleben, in the province of Saxony, and belongs to the Mansfeld Silver and Copper Company. It connects the Martin drawing-shaft with the smelting-works of Krughutte, and is constructed for the transport of minerals to the latter. The distance is 5000 ft., the line double, and its cost was 1360*l*. The endless wire-rope is 3766 metres long, and $\frac{3}{4}$ in. in diameter, and rests upon 26 timber supports of varying height, and bearing the sheaves over which the rope runs. The line is conducted over a hill, and worked by a portable steam-engine, of 12 nominal horse-power, with an upright boiler of 100 square feet heating-surface, and $11\frac{3}{4}$ square feet fire-grate. The steam-cylinder is $10\frac{1}{2}$ in. in diameter and $14\frac{1}{2}$ in. stroke, and the piston works a fly-wheel, from which the driving-pulleys, 8 ft. 1 in. in diameter, are worked. The engine works with a pressure of 44 lbs. of steam and 116 revolutions, and imparts to the rope an average speed of 446 ft. per minute, while, in 9 working hours, 120 tons of mineral are transported over the line in buckets holding 120 lbs.

each. In order to insure regularity in working the line, Gurlt's electric mine-signals have been adopted for communication between the ends and the middle of the line.

EUROPEAN STREET-CAR IMPROVEMENT.

IN Edinburgh, Scotland, where there are steep hills and where street railways are just coming into use, Mr. Gillespie has devised a safety-brake. It consists of a bar running longitudinally along the bottom of the car. A number of strong prongs project from the bar. The arrangement is such that, when the driver moves a certain lever, the pronged bar drops and the prongs strike upon the pavement, entering between the stones, and instantly stopping the car. In London, Messrs. Holmes and Taylor have invented a contrivance for storing up the inertia or power of the car lost in stopping, so as to apply that power to the starting of the car, thus relieving the horses of the severe strain now required at the moment of starting the car. The device consists of a torsional spring arranged under the body of the car, working in connection with gear-wheels upon the car-axles.

The use of springs for this purpose is very old in this country, and has been tried in various forms without much practical economy. The expense and weight of the parts proved, on the whole, disadvantageous.

STEEL LOCOMOTIVE BOILER.

Engineering describes a new steel locomotive boiler, made at the Crewe works of the London and Northwestern Railway, from the designs of Mr. F. W. Webb. It is of the ordinary type, and the barrel is made telescopic, the mean inside diameter being 3 feet 11 inches, and the plates $\frac{13}{32}$ inch thick. The most noticeable peculiarity is the system of fire-box construction, which consists of forming the front, back, and sides of one plate. A portion is cut out of the front, and the plate is flanged back to receive the tube-plate. The ends of the plate are made in a jump joint under the tube-plate and secured by a welt on the outside. The plate forming the top of the fire-box is flanged down on three sides, and is riveted to the side and back of the box and to the tube-plate. In order to insure a good joint around the tube-plate, a copper calking strip is introduced between the flanges, so that the joint can at any time be repaired from the inside of the fire-box. A $\frac{5}{16}$ inch plate is used for the body of the box, and a strong plate, $\frac{3}{4}$ inch thick, for the tubes. The dome is formed of one piece flanged at the bottom. The cover is made from a flat steel plate $\frac{7}{8}$ inch thick, and is stamped under a steam hammer into the required shape, the stamping being done

by two blows of the hammer. There are 178 tubes of steel, 1¾ inches outside diameter. The tensile strength of the plates employed does not exceed 32 tons to the square inch, and they will stretch 25 per cent before breaking. The boiler was subject to a test, by hydraulic pressure, of 200 lbs. per square inch before leaving the works.

GEAR WHEELS AND SHAFTS OF PHOSPHOR-BRONZE.

M. GILLIEAUX, of Charleroi, and M. Blondiaux, of the Thy-le-Château Society, have, from the first production of this alloy, employed it in the construction of rolling-mills, and the following are the results of three years' experience:

This bronze has been employed for the great bearings of plate and general rolling-mills, and for conical gearing in universal rolling-mills. The motive power of the steam-engine that drives the rolling-mills in which it is used is of 170 horse-power to 200 horse-power, and the speed of the rollers about sixty revolutions per minute; the engine drives a sheet-iron mill, a universal mill, and a rough-shaping mill, and is not at a stand-still for more than one hour and a half in the twenty-four. The rollers are 1.90 meters (6.23 feet) long, and 0.62 meters (2.03 feet) in diameter, and weigh five tons. It was found that the gears made of hard cast-iron broke frequently; these were first replaced by ordinary bronze, and finally by phosphor-bronze. The duration of ordinary bronze wheels did not exceed, on an average, five months, while those made of phosphor-bronze wear for about nine months. The latter alloy is found equally superior to the former when applied to bearings.

M. Blondiaux has applied phosphor-bronze, not only in the making of pinions, but in the driving axes of mills, with great advantage; in the latter case, the superiority seeming to depend not in the hardness but in the very great resistance of the alloy, the arbors in phosphor-bronze twisting much less than those made of forged iron, and not being liable to break like those of cast-iron.

UNDERGROUND LOCOMOTIVES.

IN the silver lead-mine, Mednerzhogen Bleiberg, near Bonn, underground locomotives have been introduced for some time upon the Burgfey adit, instead of the former traction by horses. The engines are made by Krauss and Co., of Munich, and are of 20 horse-power nominal. The railroad has a gauge of 2 ft. 1¾ in. only, and is 300 fathoms long. The locomotives are 10 ft. 10 in. long, 4 ft. 5½ in. wide, 9 ft. 10 in. high, and have driving-wheels of 1 ft. 10⅝

in. in diameter. The boiler is fed with coke, and is worked at 12 atmospheres pressure. The engines run with an average speed of 4 miles per hour, and in trains of 10 to 15 trucks they draw out 400 trucks of 13 cwt. each, or 260 tons of minerals in twelve hours. There is a very good ventilation in the mine, and no fear that the air will be spoiled from the combustion of fuel. It is considered that the working of these underground locomotives is connected with less danger than the working of horse-tramways, and that it insures a far greater regularity.

NEW CAR-STARTER.

AMOS WHITTEMORE, of Cambridgeport, Mass., has obtained a patent for a device whereby the momentum of the car is made to lift one end of the car in stopping, and the weight so raised is made so to act as to help the car forward in starting.

FIREPROOF SHUTTERS.

IT is well known that the ordinary iron shutter, under the influence of great heat, from a fire in an adjacent building, usually warps and twists so as to allow the fire to have access to the building the shutter was meant to protect. To make such shutters really fire-proof, W. M. Vars, of Westerly, R. I., suggests that they be made double, so as to form a water-chamber, which, however, does not usually contain water, as it would be liable to freeze and burst, but is filled, in case of a fire, by playing with a hose on the wall above it—the top of the shutter being left open, and the cap of the window made hollow, and of such shape as to readily catch the water and run it into the shutter.

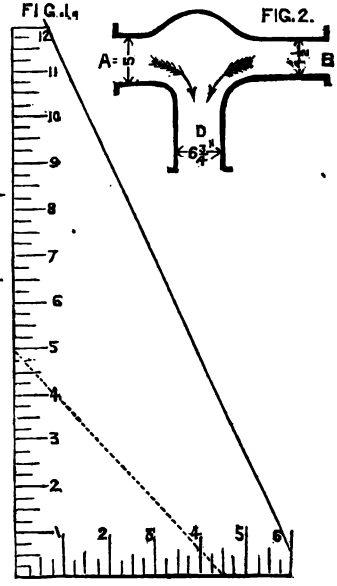
BUILDING BLOCKS made from a mixture of asbestos and plaster-of-Paris, combined with either sawdust, coke-dust, or cinders, are said by Messrs. Van Zandt & Tartiere, of New-York, to be enduring, fire-proof, strong, and yet comparatively light, and therefore easy to handle.

THE latest plan for obviating sea-sickness is the following: Construct a large well in the ship; around the centre of gravity is the best position for it. The well should have no bottom. The water in it will appear to have a rising and falling motion, but will in fact be at rest, while the walls of the well slide up and down. In this well float a small ship, and you are secure against sea-sickness. The proposer of the plan calls this "taking a small harbor to sea."

THE piles of a San Francisco wharf are cased in wood filled in with gravel, as a protection against the *teredo*. This wharf is good and firm, while other wharves, built two years later, have become weak and dilapidated.

THE PROPORTIONS OF PIPES.

We subjoin the sketch of a handy little contrivance, designed by Mr. George Cockburn, pattern-maker, Glasgow, for ascertaining the diameter of a pipe, etc., having a sectional area equal to that of two other pipes, or *vice versâ*. The instrument consists simply of a piece of wood or card-board, shaped like a set square, as shown in Fig. 1, or a diagram of the same form drawn on paper, and divided out along the two edges, which are at right angles to each other, the divisions being taken to represent inches, feet, or yards, etc., according to the kind of work for which the instrument is used. When employed for determining the equivalent diameters of pipes or bars, inch subdivisions will generally be found most convenient. The mode of using the instrument will be readily understood from an example. Suppose, for instance, that two pipes A and B, Fig. 2, respectively 5 inches and $4\frac{1}{2}$ inches in diameter, deliver into a third pipe D, and it be required to find the proper diameter for the latter pipe. Then from 5 on the scale of one of the divided edges to $4\frac{1}{2}$ on the other, draw a line, as shown dotted in Fig. 1, and the length of this line, measured with the same scale as that to which the edges are divided, will be the diameter of pipe required; in this case, $6\frac{3}{4}$ inches. On the other hand, if a pipe D, $6\frac{3}{4}$ inches in diameter, be delivered into a pipe A, 5 inches in diameter, and it was required to know what other size of pipe B could also be supplied, all that would be necessary would be to take the division point 5 on one edge as a centre, and, with $6\frac{3}{4}$ inches as a radius, describe an arc cutting the other divided edge. The point at which the latter edge was cut by this arc would show the diameter of pipe required.



Besides being useful for determining the diameters of

pipes or circles of equivalent areas, the instrument is also available for determining the sides of equivalent squares, while, by a little contrivance, it can be made available for determining the diameter (or length on the side, if square) of a pipe or bar having a sectional area equal to the aggregate sectional areas of any number of other pipes or bars of which the diameters (or lengths on side, if square) are known. To use it for this purpose it is only necessary, first, to determine by its aid the diameter of pipe or bar equivalent to any two of the whole number, and next to ascertain the equivalent of the diameter thus ascertained, and that of a third pipe or bar, and so on. The arrangement of the instrument is, of course, founded on the fact that the areas of squares and circles increase as the squares of their sides and diameters respectively, and that the square of the hypothenuse of a right-angled triangle is equal to the sum of the squares of its two other sides. (28)

COMPOUND HOSE-PIPES.

IN order to unite the power of two or more fire-engines, so as to throw a stream farther than either could separately, Chief Engineer Cronin, of the Washington Fire Department, suggests that hose-pipes be made with two or more branches at the butt end, to which may be coupled the hose of as many engines as there are branches. The exit of such a pipe should be much smaller than the total area of all the branches, to produce the best effect. To facilitate the handling of a pipe of this character, Mr. Cronin proposes to mount it on a carriage, somewhat resembling the light artillery carriage, but having the trunnion bearings arranged so that the pipe may be readily turned in any direction without moving the carriage.

THE TUNNEL AT ST. LOUIS.

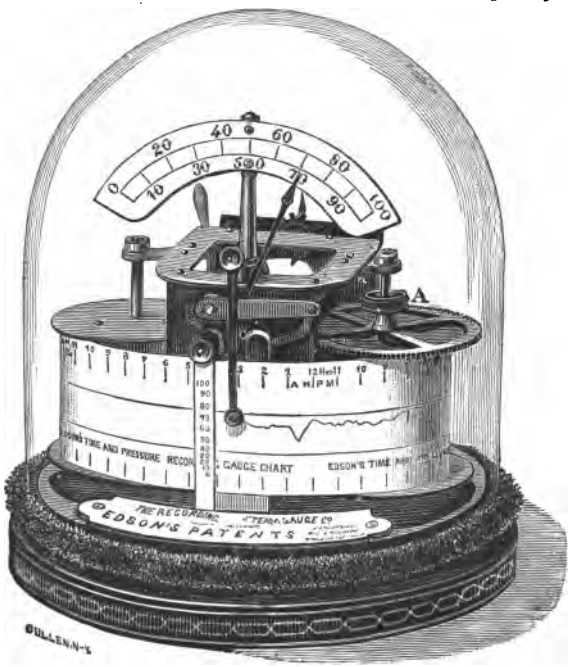
THE span of the arches of the tunnel, of which there are two, is 14 feet clear, and the height 17 feet. The arches have a depth of five lengths of brick springing from a wall of solid stone, whose foundation is six feet thick; the side walls are five feet thick to the spring line, above which the thickness of the wall is four feet; the centre wall is three feet in thickness. All the brickwork and masonry is set in hydraulic cement.

BURGLAR-PROOF SAFE.

THE latest improvement in burglar-proof safes is to line the interior with steel rods which revolve easily. After drilling through the outside casing of the safe, the bit will strike one of these rods and be deflected from its course. It will either not take hold or will be broken.

THE RECORDING STEAM-INDICATOR.

THIS is one of those useful devices intended to secure safety for human life and property which ought to be employed wherever steam-boilers are used. A small tube extends from the boiler to the instrument, and the steam-pressure operates the pointer, indicating to the eye the exact pressure in the boiler. A pencil is also connected with the pointer, and the pencil writes down upon paper



THE RECORDING STEAM-INDICATOR.

the pressure; thus we have a double indicator. A clock carries the paper, which is marked with the hours and minutes, and the instrument is thus made to record the steam-pressure at every moment of time during the twenty-four hours. If the pressure rises above an established limit, the instrument rings a gong and sounds a general alarm. The clock requires winding once a week. The paper is renewed once in three months. Each recorded day's work on the paper may be taken off and filed for reference. This

instrument may be placed on the manager's desk, hundreds of feet distant from the boiler, and still give an exact indication and record of the management of the boiler. It tells at a glance whether the engineer is faithful in his duties, and records, in black and white, the moment of beginning, and the duration of any neglect or inattention on his part. This is one of the many excellent inventions of Mr. Jarvis B. Edson, of Brooklyn, N. Y. Made by the Recording Steam-Gauge Company, 91 Liberty street, New-York.

HENDERSON'S HYDRAULIC CAR-BRAKE.

WHEN the engineer desires to apply the brakes, he simply turns the plug of a two-way cock, and the full force of the boiler pressure is brought to bear upon a water column, and a hydrostatic pressure of equal intensity is distributed to the area of every pressure cylinder under the cars. The last receives the same force as the first, and the result upon the whole is practically instantaneous.

Instead of using under the cars cylinders fitted with pistons, which again have to be kept well packed and lubricated, and connected by levers, and long rods, extending from one end of the cars to the other, with recoil springs to bring them back to their normal condition when the pressure is relieved, Mr. Henderson has made another innovation by dispensing with the whole paraphernalia, and substituting therefor an exceedingly ingenious and simple device. Between the wheels of each truck carrying the car there is placed a cylindrical vessel of cast-iron, whose ends are formed of two dish-shaped flexible diaphragms of india-rubber, secured to the drum, and making an air-tight joint at the periphery, by bolting thereto concentric rings; two rams, working in opposite directions, are fitted to the insides of the dished diaphragms. Their outer ends are attached by bolts to the cross-beams carrying the brake-shoes; when the pressure comes between the diaphragm, it simply forces them apart, and puts the brakes on the wheels in the most direct manner possible. And when the pressure is relieved, the diaphragms collapse and cause a discharge of the fluid which separated them. The peculiar construction of this device, it will be seen, possesses all the requirements of a cylinder and working piston, as well as the recoil springs. All piston-packing and stuffing-boxes are dispensed with, and no lubrication is required; the interior is sealed from dust, all complication of levers and rods and attendant lost motion is done away with, and its operation is isolated from all connection with the usual hand-gear, which remains as efficient as it was before.

One of the diaphragms and rams is dispensed with, and the casting is bolted to the outside of one of the brake-beams. Action and reaction being equal, when pressure is applied the casting presses one way, and puts its brakes directly on, and the ram going outward draws the opposite brakes on by means of two rods attached to the head of the ram, proceeding over and laying hold of the other brake-beam. The hydraulic liquid used is water and glycerine, which will not freeze under about 30° below zero. (39)

CAMPHOR WOOD.

MR. J. MELDRUM, managing director of the Johore Steam Saw-Mills Company, at Johore, India, forwards to the *Scientific American*, New-York, various interesting particulars regarding the use of camphor wood, which, he states, may be applied to all purposes for which teak is used. The camphor-tree belongs to the order *guttiferæ*, and grows without cultivation in the woods near the sea-coast. It is frequently found upward of 15 feet in circumference, and high in proportion. For carpenters' work, the wood is much esteemed, being easy to work, light, durable, and not liable to be injured by insects; and it retains a pleasant and agreeable smell. It is especially suitable for shipbuilding and for the construction of wharves and jetties, as it is not destroyed by sea-worms. Piles of this wood, in a comparatively good state of preservation, exist on the site of the old town of Johore, which was abandoned upward of 100 year ago.

Our correspondent fowards a detailed report of tests made of this material, as regards strength, weight, etc. The breaking-strain of a piece 3 feet long by 1¼ inches broad, and 1⅛ inches wide, was 1344 pounds. Its weight is 70 pounds per cubic foot. Large saw-mills have been erected in Johore for the purpose of preparing this valuable timber for exportation.

PHOSPHOR-BRONZE TWEERS.

EVERY practical blast-furnace engineer knows the inconvenience, labor, and often seriously disadvantageous consequences which are connected with the removing of a damaged water-tweer. For the purpose of obtaining a satisfactory form of tweer, I have, since 1859, carried out at the Neusser Iron Works a series of experiments with variously constructed water-tweers. The tweers mostly used in England, and made of helical iron tubes, either placed simply in loam or, as is more usual, surrounded by cast-iron, I found to give the least satisfactory results. These heavy and unmanageable lumps can not resist the

contact with the fluid iron and iron-containing slag; they are soon worn off by any contact with the fluid mass of metal, become leaky, and occasion accumulations which become so intimately connected with the mouths of the tweers that often great portions of the wall of the hearth have to be broken away in order to get them out.

I next tried wrought-iron tweers with welded seams. These gave better results, but they also could not withstand the contact with the molten metal, and became united to the latter, though the tweers were not so easily damaged as those of the first-mentioned construction.

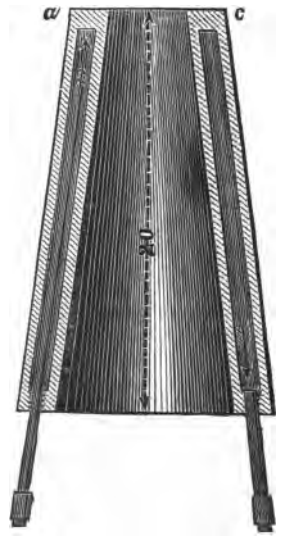
When these tweers had to be removed, the same difficulties were met with as with those previously described. It is also difficult to ascertain beforehand the perfect soundness of the weld. Some of these tweers were often not many days in the furnace when leaky seams were discovered at the mouth, thus necessitating their being taken out, and this would happen notwithstanding the perfectly satisfactory testing of the tweers with a water-pressure of from 10 to 12 atmospheres. The best mode of testing such tweers consists in filling them with water, and, after driving wooden plugs into the inlet and exhaust openings, placing the tweers perpendicularly with the mouth upon the fire, until the wooden plugs are thrown out by the pressure of steam. If the tweer withstand this test without leaking, the welded seams are then generally trustworthy.

I obtained better and, in fact, thoroughly good results with bronze tweers, and have used them for ten years. The bronze tweers form less easily a connection with the fluid metal than the iron ones, and withstand the contact with the molten iron very well. Of course, they sometimes get cracked; but in that case they are easily taken out, because the bronze, even if connected with the products of the furnace, may always be removed from them with a small amount of force. We may presume that such a tweers will sustain perhaps ten times the exposure to contact with metal and fluid slag that would be endured by an iron tweer. I use tweers of the pattern shown in the annexed sketch, and have found it the best after many experiments. If made too long and the fire is allowed without consideration to extend, the walls of the hearth suffer; if kept short, say twenty inches, it becomes necessary, with the increasing action of the fire, to renew the ramming in, and the walls of the furnace are preserved. These tweers are not easily damaged if well made, and if the precaution is taken to conduct the current of water (supplied through a ¾-inch pipe with at least a

pressure of from 30 feet to 40 feet, and more if possible) directly to the front of the tweer, in order to prevent incrustation, though that end is not entirely obtained by this arrangement. Such a tweer has to be removed every six months, in order to get the incrustation out either by means of hammering, or by drying the tweer, and making it slightly red-hot at the mouth, in which state cold water is poured into it, when the incrustation becomes converted to dust, and is washed away by the water; the tweer may also be boiled with half-diluted hydrochloric acid.

The water is introduced through ¾-inch wrought-iron tubes (gas-p pes) screwed into the bottom of the tweer, as shown in the annexed sketch, which represents a fastening that I consider to be the best.

Besides the advantages mentioned above, the bronze tweers are more durable, are more easily manageable, and are more uniformly circular, than the iron tweers, which latter property is always an advantage for the furnace. Moreover, if more expensive in their application, they are, nevertheless, much cheaper in their use than the other tweers, as the founder will always accept the old metal in lieu of part payment.



PHOSPHOR-BRONZE TWEERS.

The bronze tweers are therefore certainly the cheapest in their application, but it appears to be no easy matter to have them cast, as it is not every brass-founder who can do it satisfactorily, success depending much upon the selection of the metal and the skill of the founder; in fact, the casting of tweers is an art, like that of casting bells. I have found that intelligent brass-founders could not succeed, and even large establishments, with all their resources, have tried in vain to obtain satisfactory results. But even the bronze tweers were not perfect; they often became cracked in a manner quite inexplicable, and if they came into contact with the bed of metal from below, would tear or melt. A few years ago, my attention was called to the

so-called phosphor-bronze of Montefiore-Levy, and every thing said about it in private and public reports, and the results obtained from the trials with this metal for artillery purposes, about which a great deal has also been published in England, convinced me that the properties of this metal must offer the same advantages for tweers as for guns. It appeared, in fact, to offer greatly increased toughness and density, and, therefore, great resistance against change of temperature and the influence of molten masses. I ordered, consequently, several tweers of this metal, according to exactly the same pattern as that for the ordinary bronze tweers. These tweers have given me the fullest satisfaction; they have the advantage of being more tough than the tweers of ordinary bronze, and in cases where other tweers would certainly have burst, they sustained the shock without any damage being done to them. I ascertained further that this metal does not take up so readily or so firmly the incrustations produced by the contact with the water, and, what is of great importance, the oxidation of phospor-bronze is much more slow than that of the ordinary bronze. I have found, after a year's use, that a tweer of phosphor-bronze, when wiped with a piece of rag, appears quite smooth, and has a bright metallic surface, and that it had remained entirely without incrustation. The extra preliminary expense for phosphor-bronze appears almost insignificant in view of the advantages mentioned above, and the expense of re-casting this metal being the same as for ordinary bronze, the higher value is in the metal itself. (28)

PHOSPHOR-BRONZE.

THIS is the ordinary bronze or gun-metal.

The question, "What is phosphor-bronze?" may be readily answered by saying that it is simply the well-known alloy known as gun-metal or bronze to which a small percentage of phosphorus is added. The common gun-metal bronzes consist of from 90 to 93 parts of copper, and 7 to 10 parts of tin. The addition of a very small percentage of phosphorus makes a remarkable improvement, and gives what we term phosphor-bronze.

Without considering many minor investigations which have been made regarding this important alloy, we may here note at once that the most complete researches are those of Messrs. Montefiore-Levi & Kunzel, of Val Benvit Nickel Works, near Liège, Belgium. As far back as 1860, this firm was engaged in an elaborate inquiry into the means of improving gun-bronze, and in 1868–70 conducted a very extended series of experiments for the Russian,

government. The results of these as well as of subsequent trials are well summed up by M. Dumas in a note to the French Academy of Sciences. He says: "The characteristics of the alloys change. The color, when the proportion of phosphorus exceeds ½ per cent, becomes warmer, and like that of gold largely mixed with copper. The grain and fracture approximate to those of steel. The elasticity is considerably increased; the absolute resistance under a fixed strain becomes in some cases more than doubled; the density is equally increased, and to such a degree that some alloys are with difficulty touched by the file. The metal, when cast, has great fluidity, and fills the mold perfectly to the smallest details. By varying the dose of phosphorus, the particular characteristic of the alloy which is most desired can be varied at will."

We can now proceed to the consideration of the most recent data obtained from experiments lately concluded or actually in progress in Europe, and reported in a recent issue of the *Engineer*. In Germany, trials are being carried on at the Royal Academy of Industry in Berlin, to ascertain the qualities and capacities of the metal under heavy strain, and especially the comparative resistance to often-repeated strains, whether tensile or inflecting. A bar of phosphor-bronze tried under a constant strain of 10 tons per square inch resisted 408,230 pulls of this amount; while a bar of ordinary bronze broke before the strain of even 10 tons per square inch had been attained. A bar of phosphor-bronze under 10 tons of strain resisted 862,980 bends, while the best gun-metal broke after 102,650 bends. Another bar of phosphor-bronze, now being tested under 9 tons' strain, has thus far resisted 1,260,000 bends. In Austria, the following comparative results have been obtained:

	Absolute resistance.	Point of elasticity.	Stretch in percentage.
Phosphor-bronze	81,795 lbs. per sq. in.	54,915 lbs. per sq. in.	1.6
Krupp cast-steel	72,258 " "	14,450 " "	11.0
Ordnance-bronze	31,792 " "	5,562 " "	15.0

Best English copper sheets lost, during six months' immersion in sea-water, 3.058 per cent. Phosphor-bronze sheets lost only 1.158 per cent.

In Belgium, Messrs. Montefiore-Levi & Co. have carried on a large series of experiments, proving that the presence of oxide of tin and suboxide of copper lessens the tenacity, elasticity, and tensile strength of the bronze. Shavings of old bronze were melted, and a bar cast at 1595° C. The remaining liquid bronze was poled, and a second bar cast at 1668° C. The remaining metal was deoxidized with phosphorus, and a bar then cast at 1614° C.

The three castings were made out of the same crucible and in the same manner, into three iron molds. The results found were that the old bronze had tripled its tenacity, 6.8 as against 2 per cent, and considerably augmented its absolute resistance, (2384 to 1613.)

In England, Messrs. Alexander Dick & Co. have recently established, in London, a special foundry for phosphor-bronze casting, and are also to produce sheets, wire, etc. Experiments, made for this firm by Mr. D. Kirkaldy and carefully tabulated, show the great superiority of phosphor-bronze for all articles hitherto manufactured of ordinary bronze or gun-metal. What steel is to wrought-iron it seems that phosphor-bronze is to ordinary bronze. Another table gives the tensile strength and resistance to torsion of various wires, showing also a large superiority in these particulars of the alloy over other metals. In fact, referring to the increment of tensile strength gained by phosphor-bronze when drawn into wire, it is considered that the same is astounding; and the *Engineer* adds that, even with a large margin reserved for probable error, enough remains to prove that phosphor-bronze, drawn into wire or laminated into sheets, must prove, if practicable to be produced with perfect uniformity, a most important addition in future to the list of our constructive materials. Having pliability, with a tensile strength approaching that of steel, the specific gravity of bronze, and nearly the electric conductivity of copper, it can not fail to have important applications for the electric-telegraph engineer. For small articles, now made of brass, such as curtain-rings, picture-frames, etc., the same, cut from spirals of phosphor-bronze, with the ends soldered so as to avoid annealing the wire by conducted heat, would be an immense improvement. Although experiments toward using the alloy for artillery are incomplete, it is probable that further investigation may demonstrate its fitness for that purpose. On another page, we give a paper on its employment for tweers, for which it offers the advantages of greatly increased toughness and density, and consequent great resistance against change of temperature and the influence of molten masses. Finally, should copper become cheaper, say to double the cost of an equal weight of wrought-iron, phosphor-bronze might be used in place of iron in ship-building. It is superior to Muntz yellow-metal, a substance patented by John Scott Russell for the latter purpose, in that it does not become crystalline and brittle, while its passive strength is four or five times as great.

With our vast deposits of copper, notably in the Lake

Superior region, there appears to be every facility for the prosecution of investigations leading to the manufacture of this important and valuable alloy in the United States. We therefore consider that the subject merits the careful attention of American metallurgists, who, we trust, at no distant period, will contribute the results of their own experiments to those thus far adduced by their brethren of the old world.

The manufacture of phosphor-bronze has been commenced during the past year in the United States, and there is every prospect that it will soon become one of our most important industries.

CORRECTION OF ECHO IN PUBLIC HALLS.

THE plan of correcting echo in public halls by stretching wires across them from wall to wall, has had a practical trial in the cathedral at Cork, and given satisfactory results. From a letter published in *Nature*, giving an account of the experiments made in order to ascertain the best method of straining the wires, we take the following particulars: At first the wires were strained at a considerable height, but they produced comparatively little effect. Then a double course of wire was strained at a height of twelve or fifteen feet round the large pillars of the central tower, and other wires completely across the church. The effect of this was a greater distinctness of sound throughout the building. Further experiments were made, but none with more satisfactory results than this. When these wires were strained across the church over the heads of the choir, every sound seemed to stop at once; all resonance was gone. The matter is to be investigated thoroughly, with a view to discover the most efficient mode of correcting echo by means of stretched wires.

THE SEELY PROCESS FOR WOOD.

IN government reports on the decay and preservation of timber, Generals Cram and Gillmore recommend the Seely process as the best. It consists in subjecting the wood to a temperature above the boiling-point of water, and below 300° Fahr. while immersed in a bath of creosote a sufficient length of time to expel the moisture. When the water is thus expelled, the pores contain only steam; the hot oil is then quickly replaced by a bath of cold oil, by means of which change the steam in the pores of the wood is condensed, and a vacuum formed into which the oil is forced by atmospheric pressure and capillary attraction. General Gillmore thinks a wooden platform, *thoroughly creosoted*, would last twenty to thirty years, and be better than a stone platform during that entire period.

NEW FIREPROOF FLOOR.

In this invention, Mr. Nathaniel Cheney, of the Architectural Iron Works, New-York City, the inventor, proposes to do away with lath and other combustible building material, and apply the plaster, for ceiling rooms, directly to iron wire, which is interwoven with the tie-rods of floor or roof arches.

In our engraving, the arch A is formed of metal plates bolted together at the edges by angle-bars, and resting at the ends on metal skew-back beams B, which are tied together by wire rods C, to prevent end-pressure or strain on the walls, and hold the arch up stiff and firm. On the lower floor, the arch is made of brick, and is similarly secured, supporting a layer of concrete above.

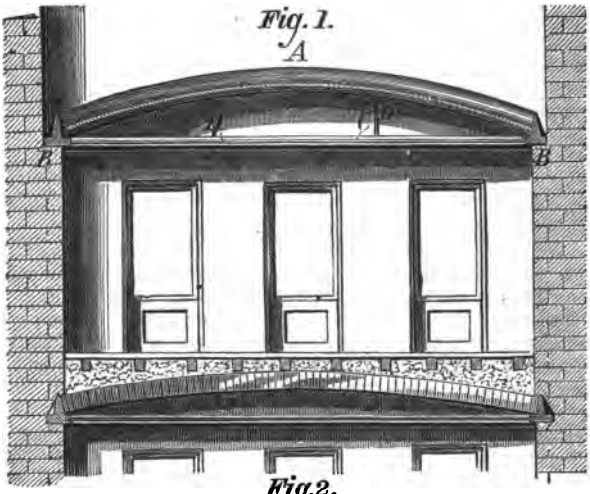


Fig. 2.

W TREADWELL & Co

NEW FIREPROOF FLOOR.

The connecting or tie-wires C are arranged close together, as shown in the section, Fig. 2, and small wire is woven in at suitable distances. The fabric is suspended by the short rods D from above, and upon it the plaster is applied in the ordinary manner. The device is necessarily fireproof, is said to form firm floors, and prevents the transmission of sound.

EXPERIMENTS ON THE RESISTANCE OF STONES TO CRUSHING.

MR. C. B. RICHARDS, C.E., has experimented upon various kinds of American building stone worked into 1-inch and 1½-inch cubes, with flat and smooth faces.

The specimens were crushed between the plane faces of two hardened steel hemispheres, the curved portions of which were seated in corresponding cavities of steel blocks, fixed in the machine. Single thicknesses of lace leather were interposed between the stones and metal surfaces; thus the pressure was uniformly distributed; it was in all cases applied to the faces of the cubes parallel to the natural bed of the stone, and carefully increased to rupture by pouring shot into the hollow weight by which the strain was caused.

Sixteen specimens of granite from 6 quarries gave from 8620 to 15,622 pounds minimum, 9838 to 18,778 pounds maximum strength. Fourteen specimens of sandstone from 3 quarries gave 5806 pounds minimum, and 8956 to 10,928 pounds maximum strength. And ten specimens of white marble from 3 quarries gave from 3905 to 12,917 minimum, and 5976 to 13,972 pounds maximum strength. Each was a 1-inch cube. The specimens failed by breaking into slender prisms and pyramids with axes normal to the pressure.

NEW WATERING-CART.

A NEW watering-cart, or van, has lately been put in operation in London. It consists of an iron tank, 7 feet 3 inches long, 4 feet 6 inches wide, and 2 feet 6 inches deep, which holds 450 gallons of water. The tank is mounted on springs and carried on four wheels with light hinged shafts, and the whole of it is painted in bright colors. The distributer and branch pipe are on the improved principle, which admits of the outflow of water being regulated to meet the varying conditions of streets and weather. An interesting competitive trial has taken place in Regent street between this machine and the old watering-cart. The pair were filled, and started from a standpost by Hanover Church, and the object was to ascertain the area of ground the water from each would cover. The two vehicles proceeded on their way toward the Regent circus till they reached Newman's yard, where the cart, having made all the running it was capable of, "compounded," while the van, "still going well within itself," proceeded as far as the circus, and returned up Regent street to Air street, where it finally gave out. The width of spread of the water from the van was twenty-three feet, that of the water from the cart being sixteen feet. By

measurement of the plans at the Vestry Hall after the trial, it was ascertained that the van had traveled 2640 feet, and had spread its water over an area of 60,720 square feet, while the cart had traveled only 1440 feet, and had covered only 23,040 square feet. The older machine has thus been signally defeated by its youthful rival.

STRENGTH OF WOOD.

PROFESSOR THURSTON reports the results of a series of experiments on the torsion or twisting of various kinds of wood. Among other interesting developments, he relates that black-walnut, hickory, and locust resist torsion up to a certain point: the resistance then becomes less for a time, when it again increases, passing considerably beyond the first maximum: it then diminishes as the wood slowly twists asunder.

This striking peculiarity, he says, was shown, by carefully repeated experiments, to be owing to the fact that in those woods in which it was noticed, the lateral cohesion seemed much less in proportion to the longitudinal strength than in other varieties. Watching the process of yielding under stress, it could be seen, by close observation, that, in the examples now referred to, the first maximum was passed at the instant when, the lateral cohesion of the fibres being overcome, they slipped upon each other, and the bundle of these loose fibres readily yielding, the resistance diminished, until, by lateral crowding, further movement was checked, and the resistance rose until the second maximum was reached. Here yielding again commenced, this time by the breaking of the fibres under longitudinal stress, the rupture taking place in the exterior fibres first.

ON THE EFFECTS OF DYNAMITE.

BY ROUX AND SARRAU.—According to the manner in which dynamite is inflamed, it is capable of producing two different kinds of explosion. When ignited by the detonation of a percussion-cap, nitroglycerine explodes with a force equal to ten times that of gunpowder. This is called an "explosion of the first order;" but if it be lighted, it may explode with a force equal to twice that of gunpowder, and occasion an "explosion of the second order." The results of a number of experiments, made with the view of ascertaining the relative explosive power of gunpowder and dynamite, led to the latter conclusion. Dynamite simply lighted will not detonate, but may produce an explosion of the second class, the force of which is such that one part of nitroglycerine is equivalent to two of powder. The thicker the resisting mediums, the more intense the explosion.

If the dynamite be prepared with quartz-sand, it inflames at once, and the explosion ensues through the whole mass; but if some yielding matter, ochre for example, be employed, the portion near the detonating fuse suffers an explosion of the first class, the remainder one of the second. Neither pressure nor temperature has any influence on these phenomena. (32, 36)

EXPLOSIONS IN FLOUR-MILLS.

OF the various explanations which have been offered to account for these explosions, there are two worthy of attention, namely:

1stly. The rapid combustion of the finely-divided flour, and,

2dly. The ignition of a mixture of air with gases furnished in the decomposition of the flour.

It has been found that flour and bran intimately mixed at 450° give off a gas which, mixed with 9 volumes of air, forms an explosive mixture that may be ignited by a spark. Wiebe is of opinion that when the apparatus of the exhauster in a flour-mill becomes very dry, such a temperature may be attained as to favor the production of this gas. The stones, which in grinding bran are very close together, strike sparks, which, carried by the current of air behind the exhauster, ignite the gas. In the combustion of wood, flour, etc., carbon dioxide and steam are formed, which at that high temperature occupy a much greater space than their elements before the combustion. Now, if a flame approach too near a mixture of air and fine wood-dust, so that some of the minute particles of dust take fire, the heat set free enables some of the neighboring particles also to ignite, and the combustion passes almost instantaneously through the entire space and seizes upon the boards, beams, etc., of the place, and the gaseous products of the combustion of the dust, by their rapid formation and expansion, produce an explosion. An explosion, arising precisely in this manner, occurred in a room in the town-hall of Friedek, by which five persons were seriously injured.

That when flour is mixed with air, and a candle is brought in contact with the mixture, it will ignite and fire off, has lately been often observed. An explosion thus occurred in the Ofen-Pesth steam-mill, destroying windows and roof. During the mixing of some very fine varieties of flour, the door of the mixing-room had been left open by a workman, and the thick cloud of flour-dust, as it spread around, ignited at a flame.

If the stones are placed too close, they strike occasionally, producing sparks, and these ignite a small portion of

the cloud of fine particles of flour and bran surrounding the apparatus, the motion of the elevator promoting the combustion by creating a current of air. The combustion thus favored passes instantly through the whole room, and the explosion follows. The use of exposed portable lights in flour-mills ought to be strictly prohibited. A violent explosion occurred last year in a mill through the contact of the flame of an oil-lamp without cylinder, with a circulating cloud of flour-dust.

The great Glasgow explosion is attributed to an accidental cessation of the feeding of the stones, the latter striking sparks, which, kindling the flour-dust in the exhauster, resulted in the blowing up of the exhauster case, the flame spreading throughout the whole mill.

Spontaneous combustion, in presence even of considerable warmth, has certainly never been observed in storehouses containing large masses of flour. (36)

NEW THEORY OF BOILER EXPLOSIONS.

By Dr. L. Bradley.—The author shows that accidents are in many cases produced, not by tension of steam, but by the explosion of oxyhydrogen gas. Under atmospheric pressure, the two elements of watery vapor, namely, oxygen and hydrogen, are dissociated at 1298° Fahr. "If, therefore," says the author, "we heat a bar of iron to fully 1298°, and place it over a globule of water upon an anvil, a blow with a hammer will elicit the detonation of a rifle. I have repeated this experient often. The elements of the water dissociate by the heat, and instantaneously recombine in cooling, causing the detonation."

The degree of dissociation, as of evaporation, depends on the pressure: under four atmospheres, (60 lbs.,) the heat required for dissociation is 1870°. But the question arises, If the vapor dissociates at these temperatures, why do not the gases instantaneously combine and detonate? The reason is plain: in the boiler the atoms at once become mixed with a volume of steam sufficient to render them inexplosive.

The condition requisite for the generation of explosive gas in a boiler is that vapor be in contact with a surface heated to 1298°, or higher, according to the pressure, as we have seen. Now, this condition may occur in a boiler filled with water, owing to the property which that liquid possesses of assuming the spheroidal shape when in contact with a highly-heated surface. "It is, therefore, not difficult to conclude," says the author, "that, in case of very heavy firing, a thin film of vapor may form between the water and the boiler, and, when this is once formed,

the heating of the boiler would be so rapid that nothing but the cooling process of dissociation, which would then commence, could save it from completely burning through."

Explosion would then occur whenever—1. The oxyhydrogen gas, as compared with the steam, *rises* to the explosive proportion; or, 2. When the steam, by condensation, *falls* to the explosive proportion. To make explosion possible, the proportion of oxyhydrogen gas to vapor must be at least as 1 to 7.

POWER OF EXPLOSIVES.

SOME experiments have been made recently in a German iron mine at Hamm, to ascertain the relative efficiency of powder and some of the nitroglycerine compounds for blasting purposes. The following were the results obtained:

Ordinary saltpetre gunpowder, 1 unit of force; extra best powder, with excess of saltpetre and cherry-tree charcoal, made by L. Ritter at Hamm, 3 units; dualin, obtained from Herr Dittmar, lieutenant of artillery, Charlottenburg, 5 units; lithofracteur, from Krebs & Co., Deutz, 5 units; colonia powder, (a sort of powder saturated with 30 to 35 per cent nitroglycerine,) 5 to 6 units; dynamite, 6 to 7 units. It will be seen that dynamite far exceeds the others in power, and its use is displacing theirs in German mines.

RECENT ORDNANCE TRIALS.

SOME remarkable results have been obtained during recent trials of naval ordnance, carried on under the supervision of Mr. Norman Wiard, at Nut Island, in Boston Harbor. Mr. Wiard's improvement consists in rifling an ordinary smooth-bore gun with two grooves, having for a 15-inch cannon a twist of one turn in 50 feet, and cut in the sides of the bore so as not to cross the bottom. The object of this arrangement is primarily to allow the gun to be used as if it were a smooth bore and with ordinary spherical projectiles, which, were the upper and lower surfaces of the interior rifled, would in balloting destroy the grooves and strain and weaken the piece, while the firing would besides be greatly impaired in accuracy.

The trials above referred to have, however, proved an unusual gain of penetrating force, due to this system of rifling. Two ordinary smooth-bore guns, of 15-inch bore, were selected, one of which was grooved according to Mr. Wiard's plan and provided with conical projectiles. The other was left in its normal condition, and ordinary round shot employed. The extremely large charge of 140 pounds of powder was used, and the projectiles weighed 460

pounds each. Two targets, of wrought-iron plates 15 inches in thickness, were erected side by side, 160 feet distant. The rifle was fired first, when its bolt went clear through the target, tearing off a huge fragment and throwing the same for a considerable distance, and then burying itself in a sand-bank. The smooth-bore shot entered the target for six and a half inches and there stuck.

The experiments were of course designed merely to determine penetrative power, and hence were made at very short range, but we understand that further experiments are to be inaugurated for the purpose of estimating the comparative distance and rapidity with which projectiles can be thrown from guns rifled after the Wiard pattern and smooth bores. It will be seen, however, that the results thus far obtained are better than those reached in the celebrated Tegel tests of the Krupp guns in Germany. Two of the cannon employed in that case were respectively of 11 and 10 inches bore. The range was 164 yards. The 11-inch gun with 88 pounds of powder drove a shell through a 12-inch plate backed by 26 inches of wood, but the 10-inch projectile did not penetrate. The English 11-inch gun, at 200 yards, with 88 pounds of powder, has sent shot through 13 inches of iron, 12 inches of wood and 1¼ inches of skin, and *The Engineer* asserts that the shot of a 12-inch 35-ton piece, with 110 pounds of powder, at 330 feet, has entered, but not penetrated, 18¼ inches of iron backed by 12 inches of teak. In the Glatton experiments, the 600-pound projectile of a 12-inch English gun, weighing 25 tons, with 85 pounds of powder, at 200 yards, pierced 14 inches of iron and 6½ inches of oak. Our American 15-inch naval gun, it may be noted by way of comparison, is of about 23 tons in weight. Until we obtain data based on range in connection with penetrative power, it will be hardly possible to draw more than a general parallel between the performances of our improved ordnance and that of foreign nations. We may here state that the official reports of the naval officers, witnessing the Nut Island tests, have created considerable interest in government circles, and it is believed that there is every probability of future experiments developing even more remarkable results. There is one all-important fact, however, which places our gun, from a certain point of view, far ahead of its foreign competitors, and that is that it is made of simple cast-iron ; while the English and German pieces are either, in the former case of wrought-iron elaborately built up or else steel, or in the latter instance, as is well known, of the cast-steel from the celebrated Krupp foundry. It is unnecessary to point out the vast diffe-

rence in the cost of such ordnance or the high superiority of American iron thus indicated.

The ordinary spherical projectiles now in use are to be improved by the insertion of three brass pins in holes equidistant from each other on the surface, and hence in the form of a regular triangle. The pins are cut to support the shot exactly in the middle of the bore, so that the windage will be equal all around and the shot receive its impulse directly from the centre of the exploding charge. The advantage gained is the prevention of the lodgments or indentation on the lower side of the bore, produced by the escape of the gas through the windage, before the ball has moved from its seat. The elasticity or crowding up of the metal causes the projectile to rebound, and on its being carried forward by the charge to strike the upper surface of the bore, and there be reflected and re-reflected before it emerges. Of course these last three indentations, termed enlargements, become gradually deeper, and, besides rendering the firing inaccurate, eventually cause the gun to become unserviceable.

We understand that the Wiard improvement does not require the manufacture of new guns, but simply a modification of those already in use. All the projectiles, equipments, etc., ordinarily employed are as available as ever, and, in brief, the idea is, merely by rifling the pieces, to give them the capabilities of both rifles and smooth bores, while besides materially adding to their range, penetrative power, and general efficiency. (83)

POWDER FOR HEAVY GUNS.

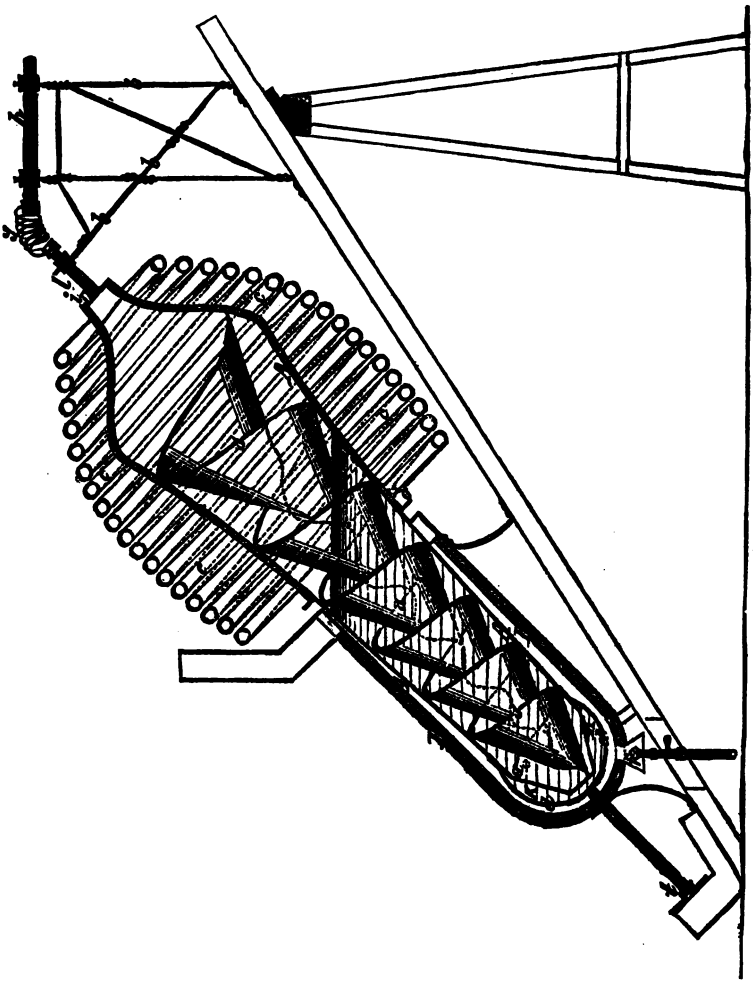
THE guns on the British iron-clad Devastation are of thirty-five tons, the largest afloat. They carry a projectile weighing 700 pounds; but it has been found that every time they are fired they score the iron decks of the ship. This at first could not be accounted for, but it is now found to be caused by the grains of powder that have not had time to be consumed within the guns. To remedy this, the guns are to be lengthened; for to move so heavy a weight as the shot they throw, a slow-burning powder is essential. The grains of the powder hitherto used have been about the size of ordinary marbles. It is now proposed to increase their size to about the bulk of good-sized walnuts, and at the same time plans are being taken at the royal gun factories to construct guns of sixty tons, with the prospect of going on shortly to seventy-five tons.

DRIVING-BELTS.—A new style of machinery belt suggested by J. F. Reigart, of Washington, consists of a flexible wire or rope covered with balls of vulcanized rubber.

NEW STEAM MOTOR.

AMONG the novelties at the World's Fair, Vienna, was the steam motor of Friedrich Siemens, of Dresden, Saxony, which is worked without the use of pumps, valves, or special moving parts, but operates through the rotation of the steam generator itself. The exertion of power begins instantly with the development of steam, and is continued by the expansion of the steam until close to the vacuum, so that the greatest possible amount of power is developed from the steam-pressure and made useful.

Our engraving, from the *Deutsche Industrie-Zeitung*, represents such a motor, one tenth the natural size. The machine consists essentially of a rotating boiler placed in an inclined position. A is the boiler or shell, inside of which there is a worm or screw *s*, made out of plates cut funnel-shape, and attached to A. At the lower end of the boiler A is provided with a double boiler *d*, while the upper end is surrounded by a spiral tube *c*, its spirals being in reverse of those of the interior worm or screw *s*. The double bottom of the boiler forms a water-space K, which communicates through circular holes *a* with the inner space of the shell A. The machine is mounted on a sloping axle-tree, which is stepped at *t*, and supported above on the shaft *l* and bar *b*. The motion of shaft *l* is transmitted to the horizontal shaft *h* by means of the flexible connection. The lower part of the shell A is surrounded by a furnace of clay B; and fire is applied through an opening at *f*. In this example a gas flame is employed. The products of combustion rise from *f* and surround the shell A, finally escaping through the upright pipe at the upper end of B. The boiler A is filled with water at *i*, and here a fusible plug is used, which melts when the temperature of the steam rises above that of a given pressure, and permits the escape of steam into the atmosphere, thus insuring the safety of the apparatus. When the fire is kindled at *f*, the steam which develops rises through the water and acts on the spirals *s*, causing the turning of the whole machine. The steam continues to rise until it reaches and enters the spiral condensing pipe *c*, which surrounds the upper exterior portion of the shell A. In passing through the pipe *c* the steam is condensed, and the water of condensation is screwed back by the rotation of the pipe *c*, down below the water-level in the boiler A, near *o*, where the water enters the boiler, and is again converted into steam. In starting the machine, the steam must first be allowed to escape at *o*, out of the spiral condenser, in order to drive out all the air; then the opening *o* is



F. SIEMENS'S NEW STEAM MOTOR.

closed, and the steam then rising into the cooling pipes *c* is condensed as before described.

The machine, if once filled and made completely tight, continues to work without requiring any other attention,

except to keep the fire going. No pumps to supply water, no valves or other devices are required; but a constant use of the same water over and again takes place; the water being first converted into vapor, which is then condensed, then again evaporated, and so on.

In lieu of water, other liquids may be employed, and it has been suggested that quicksilver might be advantageously used.

TESTING STEAM-BOILERS.

IT is generally believed that steam-boilers become weakened (for resistance to internal pressure) after continued use, from various known and unknown causes, so that the engineer can not judge of the pressure to which his boiler can be worked with safety. But this he may determine by a very simple process and means which are always at his command. It is as follows: Let the boiler be filled entirely full of cold water even to the throttle and safety-valves, and all closed tight to prevent any escape. Now, by lighting a fire under the boiler, the water will gradually expand and produce a pressure sufficient to even rupture the iron before the temperature of the water has reached the boiling-point. While the pressure is increasing, let the steam gauge or pressure indicator be watched; and when the test pressure (which may be twice or more as great as the working pressure) is reached, a portion of the water may be allowed to escape and the pressure reduced. The pressure results from the fact that water is expanded by heat more than iron. The process above given is attended with as much safety as the use of the hydrostatic press, unless the water be heated above 212°, which would not be required unless the boiler leaks. Below this temperature, no disastrous consequences would follow, even if the boiler should be torn asunder. (83)

FACTOR OF SAFETY FOR STEAM-BOILERS.

A COMMITTEE appointed by the Franklin Institute of Philadelphia, to determine a factor of safety for the iron of steam-boilers, assume the ultimate strength of a single riveted sheet to be 34,000 pounds per square inch, and recommend that 6000 pounds per square inch be adopted for the working strain. This allows a factor of safety of $34{,}000 \div 6000 = 5.67$, if we consider the ultimate strength of the material, or an average value for the factor of $(34{,}000 \div 2) \div 6000 = 2.83$, with reference to the elastic strength of the iron. When we remember that many boilers are subjected to shocks and pulsations, and that allowance must be made for deterioration and for uneven quality of the iron, this large value for the working loads seems open to grave objections.

THE ATMOSPHERIC RAILWAY IN LONDON.

IN addition to the thirteen miles of small pneumatic tubes, for sending telegraph messages between various stations, there is also in operation in that city a line of pneumatic railway, the capacity and operation whereof we find described as follows in a recent number of the London *Times:*

The pneumatic tube extends from the London and North-Western Railway station at Euston square to the General Post-Office in St. Martin's-le-Grand. The central station is in Holborn, where is also the machinery for effecting the transit of the trains. Here the tube is divided, so that in effect there are two tubes opening into the station, one from Euston to Holborn, and the other from the Post-Office. The length of the tube between Holborn and Euston is 3080 yards, or exactly a mile and three quarters, a greater length than was originally contemplated, but which was rendered necessary by the avoidance of certain property on the route. The tube is of a flattened horseshoe section, 5 feet wide and 4 feet 6 inches high at the centre, having a sectional area of 17 square feet. The straight portions of the line are formed of a cast-iron tube, the curved lengths being constructed in brickwork, with a facing of cement. The gradients are easy; the two chief are 1 in 45 and 1 in 60, some portions on the line being on the level; the sharpest curve is that near the Holborn station, which is 70 feet radius. The tube between Holborn and the Post-Office is 1658 yards in length, or 102 yards less than a mile, and is of the same section, and similarly constructed to the first length. The gradients of 1 in 15 occur on the Post-Office section, but this steep inclination is in no way inimical to the working of the system.

The wagons, or carriers, as they are termed, weigh 22 cwt., are 10 feet 4 inches in length, and have a transverse contour conforming to that of the tube. They are, however, of a slightly smaller area than the tube itself, the difference—about an inch all round—being occupied by a flange of india-rubber, which causes the carrier to fit the tube exactly, and so to form a piston upon which the air acts. The machinery for propelling the carriers consists of a steam-engine having a pair of 24-inch cylinders with 20-inch stroke. This engine drives a fan 22 feet 6 inches in diameter, and the two are geared together in such a manner that one revolution of the former gives two of the latter, or, in technical terms, the engine is geared at 2 to 1 with the fan. The trains are drawn from Euston and the Post-Office by exhaustion, and are propelled to those

points by pressure. The working of the fan, however, is not reversed to suit these constantly varying conditions; it works continuously, the alternate action of pressure and exhaustion being governed by valves. The engine takes steam from three Cornish boilers, each 30 feet long and 6 feet 6 inches in diameter. Telegraphic signaling is carried on between the three stations by means of needle instruments.

The experimental working of the tube has already formed the subject of careful investigation with several engineers, whose opinions are highly favorable to the system. In the early part of 1872, Mr. W. H. Barlow, the consulting engineer to the Midland Railway Company, instituted a series of experiments with the pneumatic tube, which extended over several days. The results thus obtained led Mr. Barlow to the conclusion that the greatest working economy of the pneumatic tube was obtained in moving a great amount of weight at low speeds. In other words, with the same number of revolutions per minute of the engine and the same pressure, a very large increase made in the load produced a comparatively small decrease in the speed. In the Post-Office section of the tube, two gradients of 1 in 15 occur; but notwithstanding this, the heaviest loads were those which produced the best commercial results. Mr. Barlow's experiments showed that 20 tons of goods were conveyed through the Euston tube in 8 minutes, and 12 tons through the Post-Office tube in 4¼ minutes. Hence, with the engine working on each tube separately, two trains of 12 tons each might be brought through the latter tube in 9 minutes, and might be sent forward in one train of 24 tons to Euston in about an equal space of time. That is to say, 24 tons of goods might be conveyed through the entire length of the tube in 18 minutes, or, allowing a delay of six minutes at the station for shifting the trucks from one line to the other, the practical result would be the transport of one ton of gross load per minute.

The practical conclusions to which the preceding remarks point are, that there exists at the present time, in good working order, a rapid and efficient means of transit for parcels between one of our leading railways and the Post-Office, with an intermediate station. The system is now open to the public for the conveyance of goods, and the public are availing themselves of the benefit it confers. The comparatively limited extent of the district served means, of course, for the present, proportionately limited commercial results. It remains, however, for the Pneumatic Company to prove the soundness of their scheme by

regular systematic working, and so to gain the confidence of the postal authorities and the railway companies, to whom the pneumatic tube should prove a great boon. Useful as the system is at present arranged, it requires but slight exertions to very materially increase that usefulness. It has already one of its termini at the Euston Station, and the proximity of the Midland and the Great Northern stations at once suggests short extensions to both of those points. Again, the relative position of the Holborn station with that of the South-Eastern Railway at Charing Cross, and of the Post-Office station with that of the same railway at Cannon street, would render an extension in either of these directions no very difficult matter, while all parties would apparently be benefited by the result. Then there are the district offices of the postal system, most of which might be placed in direct communication with the chief office by means of the pneumatic tubes, in the same way that, to some extent and by means of small tubes, the postal telegraph offices are connected at the present time. Should the satisfactory results of experimental working be borne out by the practical trial this system is now undergoing, there appears to be no reason why it should not be generally extended to all parts of the metropolis and the suburban districts.

COMPLETION OF THE HOOSAC TUNNEL.

THE bore through the Hoosac Mountains, Massachusetts, was completed on the 27th of November, 1873. The back volumes of SCIENCE RECORD contain accounts of the progress of this great work from its incipiency up to its completion, together with engravings of the various kinds of mechanism that have from time to time been employed.

When the Hoosac Tunnel was authorized, no railway-tunnel of equal magnitude had ever been undertaken, and the project seemed almost impracticable, for lack of suitable mechanical means. The method of hand-drilling through the mountain rocks, for a distance of five miles, made the job seem almost interminable; and calls were made for the invention of new and special machinery, whereby the work could be expedited. This was in 1858. The ingenuity of the Yankee was not long in responding to the call; and in the course of a few months, the contractors had the satisfaction of setting at work, against the face of the mountain, an enormous machine composed of a great wheel faced with steel cutters, by which they expected, at one operation, to cut a finished tunnel in the most rapid manner. But in this they were doomed to disappoint-

ment. The machine began its revolutions, and cut its way into the rocks very nicely for a few feet, when it broke down, and gave such evidence of impracticability that it had to be abandoned. The builders lost a large amount of money, and complications followed which practically suspended the work, although, from time to time, up to 1868, some progress was made by hand-drilling, and paid for by State funds. Other inventors had in the mean time succeeded in constructing new and improved drilling machinery, of an effective nature, and in 1868 Messrs. W. & F. Shanly signed a new contract, guaranteeing to complete the tunnel by or before July 1874. They set vigorously to work, employed the pneumatic drilling machinery, and have now successfully pierced the mountain. Their portion of the work will be finished in advance of the period fixed by their contract.

The work extends from the Hoosac River, at North-Adams, Mass., on the west, through the Hoosac Mountain to the Deerfield River on the east; and when completed, will open a new line of railway travel, by easy grades, from Boston and the northerly portions of Massachusetts to the Hudson River.

The tunnel has a length of 25,031 feet. Its dimensions are 24 feet in width and 20 feet in height above the railroad-track when laid, with a central covered drain two feet square. Its form is a rough semicircle, the variation being such as to give greater height at the sides than could be given by a true semicircle. It has cost, principal and interest, a little more than $12,000,000. This includes railway work outside of the tunnel. The actual cost of the tunnel proper and approaches is put down at $10,000,000.

THE FIRELESS LOCOMOTIVE.

THIS form of locomotive-engine, run by steam generated from hot water forced into it from a stationary boiler previous to the start, is gradually fulfilling the anticipations of its projectors, and promises to lead us to a practical substitute for horse-power in working city railroads, tunnels, and suburban lines.

A trial of a locomotive of this kind recently took place between East New-York and Canarsie. The dimensions of the engine were as follows: Boiler, 10 feet long by 46 inches diameter; two cylinders, 8 inches diameter by 12 inches stroke; two pairs of wheels, 30 inches diameter, coupled; ordinary slide-valves, working without expansion, the engine being provided with double eccentrics and links for reversing. The exhaust is blown into two condensers, one for each engine, fitted with 36 five-eighth-

inch tubes for promoting condensation, and air-pumps for creating partial vacuum. Its performances were as follows: With the steam-gauge at 180 pounds, it ran the 3½ miles in 12¼ minutes, when the gauge showed 108 pounds. During a 9 minutes' stoppage, it fell to 104 pounds, and the run back, (up grades,) in 17 minutes, reduced it to 45 pounds. No fire was used on the locomotive, the entire trip having been made by the steam rising from the hot water with which the locomotive was charged at the start. It drew one car with 120 passengers. The net weight of the engine was 4 tons 3 cwt.; the car itself was estimated to weigh 7½ tons empty, and with its load 12½ tons.

We understand from Mr. Schieffler, of the Grant Locomotive Works, Paterson, N. J., that an engine to be worked on this plan is to be designed and constructed at that establishment. It is well known that street passenger-cars may be propelled by steam power at less cost than by animals, and it is hoped that this new plan will prove successful. (83)

IMPROVEMENTS IN THE PROPULSION OF VESSELS.

THAT there is a pressing need for improvement in our steam mercantile marine is apparent to all engaged in shipping, and is shown by the increased number of orders which are being received by builders for new sailing ships, compared with the orders for steamers. This apparent tendency to return to sailing ships, which characterizes the present time, is no doubt due to two causes—namely, the expense of working steamers, and the great losses which have occurred among them. Both of these objections are proposed to be removed, to some extent, by Mr. Griffiths' plan, which combines the most desirable feature of separate engines at the bow and stern, with, as it is contended, an equal speed and less expenditure of power. On this latter point, we have witnessed a large number of experiments, the details of which we hope shortly to publish, and shall therefore content ourselves, on the present occasion, with giving a brief outline of their results. They were made with a couple of models, so arranged that they could be propelled in the ordinary way or on the tunnel system, and every care and attention was paid to insure the power applied being accurately recorded, as well as the number of revolutions of the screws.

Experiments were made with the whole power concentrated on one screw at the stern, and afterward with the power divided, placing half in a tunnel in the bow, and the

other at the stern; and the increased speed with the new system was very striking indeed, amounting to about 30 per cent in some of the runs; but this doubtless was assisted by other causes, to which we shall hereafter refer.

The most curious results of the trials appear when the model is tested with the engine at one end only at work, and compared with the result obtained with the screw working at both ends, and with the power doubled. It is well known that in ordinary vessels when the power is doubled, the speed is increased by one fourth; but in these experiments, trial after trial appear to show that when the power is doubled by adding a screw in the bow working in a tunnel, the speed is increased by one half.

(28)

THE INTEROCEANIC CANAL.

THE Secretary of the Navy in his annual report states that the expeditions authorized by Congress to survey the Isthmus of Darien, with a view toward the completion of a canal between the Atlantic and Pacific Oceans, have finished their labors. The preliminary operations to actual construction are therefore completed, and it now remains for Congress to determine whether the routes, indicated by the officers engaged for so long in this arduous duty, present sufficient advantages to warrant the undertaking by the Government of this very important enterprise.

Two surveys have been made. The Darien expedition, under Commander T. O. Selfridge, has selected a route including 100 miles of river navigation of the Atrato, which stream has been found to offer a sufficient depth of water for the heaviest class of vessels. Between this river and the Pacific, a canal is necessary, 28 miles in length; 22 miles of this distance is over a plain having a gradual rise of 90 feet. Finally, there will be three miles further of open cut, and three miles of tunneling to reach the Pacific. It is estimated that the work will cost from $50,000,000 to $60,000,000, and could be completed within ten years.

Commander Lull, in charge of the Nicaragua expedition, has determined a practicable route for an interoceanic ship canal, having Lake Nicaragua as its summit level. It is proposed to connect this lake with the Pacific by a canal 16·33 miles in length, beginning at the mouth of the Rio del Medio, and terminating at Brito. The first 7·5 miles will require an excavation averaging 54 feet in depth, and will constitute the most expensive part of the work. Ten locks and one tide lock will be required, and there will be 56 miles of lake navigation.

The San Juan River will be navigated to the mouth of the San Carlos, and will be improved by four dams, in order to get around three of which short canals must be built. From the fourth dam to Greytown, an independent canal 41·9 miles in length is needed. The total length of the canal is 61·74 miles, of which 47·34 miles are an embankment and excavation. No tunneling is required, and it is believed that Lake Nicaragua will supply 38 times the maximum demand of water. The route surveyed by Commander Selfridge seems to be much more direct and easier to construct.

PROPOSED TUNNEL BETWEEN SCOTLAND AND IRELAND.

FOR many years there have been projects more or less before the public for uniting Scotland and Ireland by means of a tunnel; and the scheme has recently been again put forward—this time, however, with some reasonable probability of its being carried out. A single-line tunnel, 15 feet wide at base, 25 feet wide at the maximum, and 12 feet high, the side walls of which would vary from 4 to 7 feet in thickness, is estimated by the present projectors to cost nearly $23,000,000, with the approaches. The length of the tunnel would be about twelve miles, and it would extend from a point on the north shore of Ireland, near Belfast, under the Irish Sea, to the extremitv of the peninsula opposite, in Scotland.

SLAG AS A BUILDING MATERIAL.

AT a recent meeting of the Society of Engineers, London, a paper was read on the economical use of blast-furnace slag by Mr. Perry F. Nursey. The author commenced by noticing generally the history of the utilization of slag. In that condition it was first used for the beds in pig-iron foundries and afterward in producing fine castings. It was also mixed with lime in certain proportions, and then pressed into bricks and made into concrete and cement. Slag sand was also used in making mortar with very good results; it was further utilized as ballast on railways, and had also been adopted in the maufacture of glass. In England, the author stated, it had also been similarly applied, and systems of machinery for its utilization had come into practical operation. The machinery of Mr. C. Wood, of Middlesborough, and of Messrs. Bodmer, of Hammersmith, was then described by the author by the aid of diagrams and models. Mr. Wood's machines, he explained, were of two kinds, one of a horizontal revolving table, and the other a vertical revolving drum. By the first machine the slag was cooled with a stream of water

as it left the furnace, and, becoming disintegrated, was broken up and pushed off the table at a certain point by scrapers into trucks placed beneath. In that state the material was in a suitable condition for making concrete for building purposes. The second machine was for reducing the slag to a finer condition. It was run from the furnace into the drum, through which a stream of water flowed. The drum had screens placed within it, and as it revolved the slag became reduced to a fine sand, and was delivered in that condition into trucks. The sand was utilized in making bricks, cement, mortar, and for other similar purposes. Messrs. Bodmer's plan consisted in the use of a pair of rolls, through which the slag was run from the furnace on to a traveling band, which delivered it wherever required. The sheet of slag thus produced was readily broken up for use in concrete-making or ground into powder for bricks, cement, or mortar. For some purposes, Messrs. Bodmer ran the slag into water, but for bricks and cement they produced it dry. They had also a special system of machinery for the manufacture of slag bricks, which was worked by hydraulic power, and which was described by Mr. Nursey. Samples of sand produced by both processes were exhibited, as were also bricks, concrete, and cement made from them. The satisfactory results which the author showed had followed the extensive use of blast-furnace slag in the form of building materials leads to the hope that the enormous heaps of slag in the iron districts will become a source of profit, and will provide good sound building materials at a low cost.

A NEW MODE OF CONDENSING THE LIQUEFIABLE MATTERS HELD IN SUSPENSION IN GASES.

By Mm. E. Pelouze and P. Audouin.—It is well known to all gas engineers that gas, as it passes from the retorts, carries along with it a quantity of liquefiable matters (tar and ammoniacal liquor) to the amount in general of 12 per cent of the weight of the coal distilled. Only 4 or 4½ per cent, however, condenses in the hydraulic main, although the temperature of that part of the apparatus is always below 212° Fahr., while the boiling-point of the tar is above 600° Fahr. The reason, no doubt, is that the liquid particles are present in the gas in the vesicular form. The reduced temperature, which it is easy to obtain by the employment of a refrigerating apparatus, is not sufficient to cause the condensation of these particles; and it is only by carrying the gas a long circuit, and using a coke condenser, that they can be so completely removed that the

tarry matters may not interfere with the action of the purifying materials. It may be asserted, however, that, in a majority of works, and especially at the time of greatest production, the gas is not completely deprived of the matters which ought to be removed before it reaches the purifiers.

The new mode of condensing, invented by the authors, is founded upon the principle that the liquefaction of the globules, held in suspension by the gas, is brought about by the contact of the particles either with solid surfaces or with each other; the object is to obtain, by the aid of a very simple apparatus, occupying but a small space, the complete condensation of the liquid particles carried along by the gas or vapor.

The action of the apparatus is as follows: The gas to be purified is made to flow through a series of holes of small diameter, so forming jets, which strike against a surface placed opposite. In the passage of the gas through the holes, the liquid molecules are brought into close contact with each other, and the action is completed by the contact with the solid surface upon which the tarry matter is deposited.

The intimate contact between the liquid globules and the gas which holds them in suspension, obtained by the use of this apparatus, effects the condensation of some matters (ammonia, sulphureted hydrogen, bisulphide of carbon) which hitherto have only been removed by complicated methods, sometimes injurious to the illuminating power of the gas, (washing with liquor, etc.) It must be added that, by passing the gas, properly cooled, through the apparatus, any naphthaline is completely eliminated and retained along with the tarry matters.

A high pressure is not necessary to the use of the apparatus, eight tenths of an inch of water being sufficient in ordinary cases. It may be placed either before or after the exhauster; if before, a weak vacuum must be maintained.

The most striking result of the use of the apparatus is the almost complete removal of sulphureted hydrogen from the gas, and it follows that a very important economy in purifying materials must be effected wherever it is employed. An apparatus has been in operation in one of the Paris works, at which the daily make exceeds 350,000 cubic feet, for several months with perfect success; and others are now to be installed in all the works of the Paris company. The gas, after passing through this apparatus, the capacity of which is less than a cubic yard, is found to be completely deprived of tarry matters; while the tar deposited is rich in oils, and the ammoniacal liquor

collected is larger in quantity and more than twice the strength of the ordinary condensed liquor.

In conclusion, it is said that numerous photometric experiments have proved that the gas loses none of its illuminating power in passing through the apparatus.

FUEL FROM COAL-DUST.

By E. F. Loiseau.—Dust of bituminous coal or anthracite is mixed with about 7 per cent of plastic clay and made up into bricks, which are dipped into ordinary benzole containing colophony in solution. They are then exposed to a current of air, whereby the benzol is evaporated and a coating of rosin is left on the surface which renders the coal-bricks perfectly water-tight.

METAL CASTING UNDER COMPRESSION.

By Smith & Locke, of Boston, Mass.—The patterns are first brushed over with a mixture of olive-oil and paraffine, after which they are coated with a slip composed of clay and fine sand. They are then placed in a flask which is filled in with a mixture of terra cotta (the old moulds ground to powder) and clay. The flask is then placed under a powerful press, and submitted to a pressure of 400 lbs. per square inch, the mould thereby becoming condensed. From the press the moulds are taken to a furnace, where they are hardened, and when ready they are placed in a casting chamber, to the number of ten or twelve at one time. The chamber is then tightly fastened, and the molten metal is forced into it, becoming distributed among the moulds, and entering into the most delicate tracery of the patterns. The metal is injected through a cylinder attached to one end of the casting chamber, in which a piston is fitted, the cylinder being lined at each operation with a non-conducting substance, which prevents refractory metal from becoming chilled or adhering to the cylinder, and at the same time serves as a packing for the cylinder. The end of the cylinder next the mould-chamber is fitted with a clay heading, to which is a gate stopped by a movable plug, and opening into the chamber. The molten metal having been run into the cylinder, the piston is screwed up, slowly at first and afterward quickly, when the plug is forced forward into the chamber, the metal following it, and running into the moulds under considerable pressure, which is maintained until such time as the metal has set.

The process has been in operation at Somerville, near Boston, since the 1st of May, 1869, where Mr. Smith has produced round as well as flat castings, such as ornament-

al columns. He has also cast monumental tablets 7 feet 6 inches high, by 3 feet 6 inches wide, and one quarter inch thick, notably one to the memory of 400 soldiers, whose names were all cast on it. The process is both ingenious and successful, and is capable of a wide range of application in the arts and manufactures.

THE MECHANICAL PRINCIPLES OF FLYING.

L'Aéronaute, a journal devoted to the interests of aërial navigation, contains a valuable contribution to our knowledge of the mechanical principles of the flight of birds, in an article by M. A. Penaud. The elaborate experiments of Thibault on the resistances opposed by the air to motions of thin plates of metal form the basis of the mathematical studies of Penaud, as well as of those by Louvrié, published in 1868. Thibault's experiments showed that, in moving a plane square surface, the resistance normal to the surface remains very nearly constant so long as the angle between the normal and the direction of motion (the angle of incidence) is included between 90° and 45°; it then diminishes progressively to 20°, from which point up to 0° of incidence it is sensibly proportional to the sine of the angle. M. Penaud now demonstrates, first, that a bird sailing in the air falls as slowly as possible when he employs for his horizontal movement one fourth of the work of the fall; second, a bird, in sailing with a uniform movement, clears a given space with the least possible fall when the work of suspension is sensibly equal to the work of translation; the plane of the wings then bisects the angle formed by the horizon and the direction of movement, and the latter angle is itself a minimum.

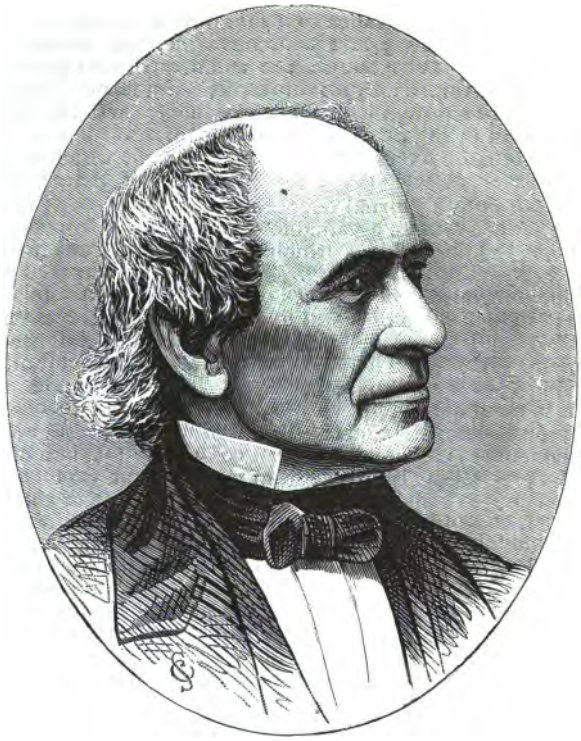
From these principles, (which apply to birds, and not necessarily to insects,) Penaud deduces most of the known characteristics of the flight of birds. For insects as well as for fishes, the modes of propulsion involve quite different principles of mechanics.

NEW RAILWAY BRIDGE.

THE new bridge over the Connecticut River at Springfield, Mass., is nearly completed, and trains pass over it. The old bridge, which has stood for twenty-eight years, has been removed.

PREVENTING INCRUSTATION IN BOILERS.

R. A. FISHER, of San Francisco, states that if a body of quicksilver, or any easily fusible metal or alloy, be placed in the bottom of a steam-boiler, it will by its agitation prevent incrustation.



ALVAN CLARK, THE ASTRONOMICAL ENGINEER.

NEW REFRACTING TELESCOPE OF THE NATIONAL OBSERVATORY, WASHINGTON, D. C.

By Simon Newcomb.—When we trace back the chain of causes which led to the construction of the great Washington telescope, we find it to commence with so small a matter as the accidental breaking of a dinner-bell in the year 1843 at the Phillips Academy, Andover, Mass. One of the scholars of the Academy, George B. Clark by name, gathered up the fragments of the bell, took them to his home in Cambridgeport, put them into a crucible with some tin, and proceeded to melt them in the kitchen-fire. His mother very naturally inquired the cause of such an interference

with the culinary arrangements, to which he replied that he was going to make a telescope. Having melted his metals, he cast them into a disc, and commenced grinding them into a slightly concave mirror. His father learning what he was doing, lent a helping hand, and the combined skill of father and son was soon rewarded by the completion of a five-inch reflecting telescope which would show the satellites of Jupiter, the rings of Saturn, and other telescopic objects.

Such was the origin of the now well-known firm of Alvan Clark & Sons. The father was then a portrait painter in Cambridgeport, and within the limited circle of his acquaintance the accuracy of his portraits and the patience which he devoted to their finish brought his work into high esteem. He was entirely self-made, having received no higher education than that afforded by the district school of his native place, or by his own reading; but this defect was more than compensated by his natural genius, which was of a much higher order than that of the so-called practical man. It is interesting to notice the early development of those qualities he has since exhibited in the construction of telescopes. At the time of which we speak, he was much more widely known as a champion shooter with rifles of his own make than he was as a portrait painter. His success in this apparently unartistic and unscientific pursuit was due to the extreme accuracy with which he cut the bores of his weapons, and figured his balls, and to the precision of his eye-sight.

He now entered with ardor upon the path so curiously opened up by the experiment of his son. He made reflectors of larger size, and began to employ them in scanning the heavens. Among other objects he examined was the great nebula of Orion, that celestial mystery which nearly every great telescope of the world has sought to unravel. He confined himself to making a little map of all the small stars he could see in the nebula, and when it was done he exhibited it to Professor Bond, the director of the newly-founded observatory at Cambridge. Surprise was expressed at the number of minute stars Mr. Clark could see with so small an instrument, and the astronomer remarked one in particular which Herschel had not seen with his twenty-foot reflector.

Mr. Clark now began to consider the feasibility of grinding the glasses of a refracting telescope.

During several years Mr. Clark devoted his leisure to the making of glasses of gradually increasing size, which he mounted in the simplest manner, and generally sold to

private individuals. The first scientific recognition of Mr. Clark's genius in the difficult art he has pursued with such success came from Europe. The Rev. W. R. Dawes, of England, was, at the time referred to, one of the leading amateur astronomers in England, and was celebrated for his performances in the measurement of double stars. He was among the finest and most critical judges of telescopes living, while his personal character and virtues corresponded to his intellect. To him Mr. Clark ventured to write without any introduction, describing his efforts in the construction of telescopes, and stating what he had been able to do in resolving the very difficult triple star of Andromeda. This letter opened a correspondence which lasted as long as Mr. Dawes lived. The latter began by sending Mr. Clark a list of certain difficult celestial objects which he wished him to examine and describe. This was done in a manner so satisfactory to Mr. Dawes, that he made a proposal to purchase Mr. Clark's glass, which the latter accepted, and the glass was sent over to England in the autumn of 1853. Its performance was so satisfactory that Mr. Dawes soon ordered a second. The reason for sending these orders to America was that there was not, at that time, an establishment in England which could grind a large object-glass into accurate shape, so that English astronomers were in this respect entirely dependent upon the two or three German houses who possessed the art. When a thirteen-inch telescope was constructed for the Royal Observatory, Greenwich, it was found necessary to send to Munich for the object glass.

Mr. Clark's reputation now became widely extended in his own country, and he was able to turn his entire energies to his new profession with a good prospect of success. About 1859, he procured glass for the construction of the largest refracting telescope yet made. The great pair of refractors made by Merz and Mähler for the observatories at Pulkowa and Cambridge had reigned without rivals for about twenty years. The clear aperture of the object-glass of each was about fifteen inches. The disks which Mr. Clark now commenced to work were large enough for a clear aperture of 18½ inches, and would therefore admit about fifty per cent more light than the instruments of Cambridge and Pulkowa. This glass was completed in 1862, and was scarcely pointed at the heavens in its temporary tube when a remarkable discovery was made with it. To comprehend the interest of this discovery, we must mention a circumstance in the recent history of astronomy.

It is perhaps half a century since Bessel found, by a comparison of Bradley's observations of Sirius, made be-

tween 1750 and 1756, with his own, that the motion of that star exhibited a remarkable peculiarity. It did not move in the heavens in a straight line with a uniform velocity like other fixed stars, but varied its motion in such a way as to indicate that it was revolving around some centre very near it. Bessel could not doubt that this force was due to the attraction of an invisible satellite moving around the bright star. Some years afterward, Dr. C. A. F. Peters, by a careful study and comparison of all the observed right ascensions of Sirius, was able to calculate the orbit of the attracting body. Afterward, Mr. T. H. Safford was led to the same result by a study of all the observed declinations of the star, so that there could no longer remain any reasonable doubt that the satellite really existed, though it continued to elude the most careful search.

On the evening of January 31st, 1862, Alvan G. Clark pointed the newly finished glass at Sirius, probably without any knowledge of the researches to which we have alluded. "Why, father," he exclaimed, "there is a companion!" The father looked. There was the satellite surely—distance about ten seconds. As the news went round the world, every great telescope was pointed at Sirius. Now, when it was known exactly where the companion was, it was found that many telescopes would show it, and measures of its distance and direction flowed in from all quarters. The French Academy of Sciences awarded Mr. Clark the Lalande medal, which is given annually to the maker of the most interesting discovery of the year. It was awarded not simply for the discovery, but also for making the object-glass which led to it.

The important question whether the satellite was really the disturbing body which had been predicted could only be settled by long-continued observation. After four years, it was found that the observed position and motion of the satellite both corresponded so nearly with those predicted from theory that no serious doubt of the identity of the seen and unseen bodies could be entertained.

In 1870, Congress ordered for the National Observatory, Washington, a new telescope with a 26-inch object-glass, the largest in the world. The price was limited to fifty thousand dollars, and ten thousand were appropriated for the first payment. Mr. L. J. McCormick, of reaping-machine fame, had conceived the idea of getting the largest telescope that could be made for an observatory he intended to found, and sent an order to the firm of Alvan Clark & Sons while the appropriation was still pending in Congress. Mr. Clark, however, believed that he could complete a pair of twin instruments almost as quickly as

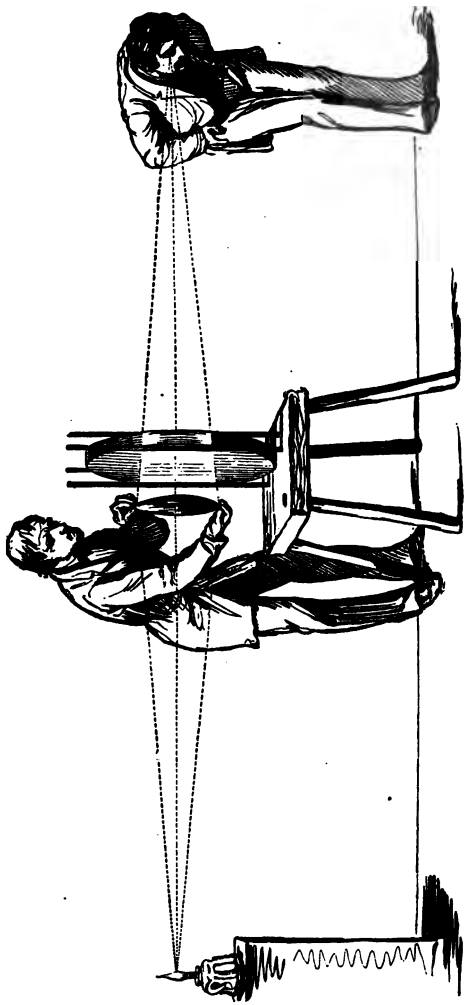
a single one, and in one way the contract with Mr. McCormick facilitated that with the government. It being made on a gold basis, Mr. Clark was quite willing to enter into the government contract on a currency basis, which removed one of the principal difficulties in its way. The question who should have the first telescope was amicably settled by Mr. McCormick's withdrawal of his claim to it.

As the only establishment in the world to be intrusted with the making of the instrument was that of the Clarks, so only a single firm could be relied on to furnish glass disks of the necessary size and purity for the lenses, namely, that of Chance & Co., of Birmingham, England. Making disks of the required size proved to be a task of such difficulty, that more than a year elapsed before entire success was reached, a number of trials having failed in the mean time.

In an objective, as made by the Clarks, the flint glass has only one curved surface, while the crown has two. The effects of the two glasses in dispersing the light are equal and opposite, while the crown, having, by its two curved surfaces, the excess of refracting power, brings all the light to a focus.

The completed disks of flint and crown glass reached Cambridge in December, 1871. By the terms of the contract, the first payment of ten thousand dollars was to be made when the glasses were tested and found of proper quality; they were therefore prepared for examination as soon as possible. The tests were made by direct optical examination, and by polarized light. To apply the first, the glass was set up on its edge between firm supports, in the middle of a large, nearly dark room. A lamp was set at one end of the room, so as to shine upon the back surface of the glass at right angles; behind the glass was placed a large lens of short focus, so that the light of the lamp passed through both the lens and the disc, and came to a focus at about an equal distance on the other side. The eye being placed exactly at this focus, that portion of the glass disc backed by the lens appeared as a brilliantly illuminated surface, on which the slightest defects were magnified in a startling degree. The minutest specks, bubbles, and scratches appeared as huge deformities, and any vein of unequal density would appear as a wave on the bright surface.

This first test having been successful on both glasses, that by polarized light was applied. To apply the test, the glasses were taken into the open air, and laid on the ground upon a piece of black cloth. Each glass was then



THE GREAT REFRACTING TELESCOPE.—TESTING THE GLASS.

viewed in such a way that the light of the sky or clouds should be reflected from its under surface, and reach the eye after twice traversing its thickness. This light was viewed through a Nicol's prism held in the hand, and turned round and round, the glass also being turned round so that the light should be examined in all directions. The result indicated that the flint glass was perfectly uniform, while in the crown there were very slight circles of strain from the centre to the circumference. This defect would not interfere with the usefulness of the glass, and curiously enough, it disappeared during the grinding, so that when the lenses were completed, no trace of unequal annealing could be seen.

The application of these tests was completed early in January, 1872, and the work of grinding was immediately commenced. Owing to the great size of the glasses, the first rough grinding was done by machinery, the "grindstone" being a rapidly revolving iron wheel, over which a stream of water and sand was kept running. The glasses were thus roughly brought to the desired shape in a few days. The forms chosen were much more simple than those usually employed in large glasses, the crown glass being double convex, with an equal curvature on each face; the flint, nearly plane on one side, while the other side was concave, with the same curvature as the crown glass.

The process of grinding and polishing was now carried on in the usual manner. The tools are very simple—round plates of cast-iron, about three feet in diameter, hollowed out to suit the curves of the lens. They have somewhat the appearance of huge shallow saucers, or more nearly still, of the shallow iron drinking-cups attached to pumps or hydrants in some of our cities. Three of these tools were necessary, one nearly flat, for the inner surface of the flint glass, one convex, for its outer surface, and one concave, for the crown glass. The surface of the tool is covered with coarse emery and water, the glass is laid upon it, and the grinding is carried on by sliding the glass back and forth on the tool. While sliding, the glass is slowly turned round so that the grinding strokes occur successively in every direction on the glass, while, at the same time, the operators continually move around in the other direction, so that the strokes are made successively in every direction on the tool. The result of these combined motions is that every inequality, either on the glass or the tool, is gradually worn away, and both are reduced to portions of nearly perfect spheres. When this result is attained, the grinding is continued with emery of continu-

ally greater degrees of fineness, until the surface becomes quite smooth.

The next operation is that of polishing. The whole tool is covered with a thin coating of pitch, which is pressed while still warm into the proper shape. It is then covered with a layer of water and the polishing rouge, and the glass is again laid upon it, and kept in motion in the same way as in the fine grinding. Thus each surface of the two glasses is speedily brought to a high polish.

The operations we have thus far described require no extraordinary skill on the part of the workman. With a little patience and practice, almost any one can make himself a better glass than any known before the invention of the achromatic telescope. But such a glass would by no means serve the purposes of astronomy now, and the chances of a glass of any size turning out exactly right on the first trial are very slight. The skill of the optician is now called into play to rectify the figure. Two formidable difficulties have to be overcome, to find what the defects of the glass are, and where they are situated, and then to remove them without introducing others. To find the defects, the glasses are put together, set up on edge, facing a luminous point at a distance equal to ten or fifteen times the focal length. The image of the point formed in the focus of the glass is then examined with an eye-piece of high power, or the eye is placed exactly in the focus, and the aspect of the glass noted as the light from the point passes through it. By these means, the skilled optician can judge where the curves of the glasses are too great, and where too small.

The glasses are now taken back to the tool and the polishing process is recommenced, only pressing upon those parts of the glass where it has to be ground away. The glass is then tried again, and again returned to the polisher. The defects in a small glass can be thus polished away in a few days; but as the size is increased, the process becomes more and more tedious, and the difficulties of judging what the defects are, and of handling the glass on the polisher so as to diminish them, increase enormously. It is in this tentative process of gradually working out every defect of figure, and even in compensating defects in the uniformity of the glass itself by a suitable change of figure, that the Clarks have exhibited their unrivaled skill. So tedious did they expect the process to be in the case of the great telescope that they asked three years for its completion. But the glass was worked into shape with unexpected rapidity. We have said that the operation was commenced in January, 1872. In the month

of June following, the glass was in such good shape that only an expert could see any defect whatever. Looking through it, we could read a microscopic photograph, illegible to the naked eye, at a distance of some four hundred feet. Had an opportunity offered, we might have read a love-letter over a young lady's shoulder half a mile away. Artificial double stars, one third of a second apart, were clearly separated. In hands less severely critical than those of makers, it would have passed as optically perfect. Nevertheless, four months more were spent on it, and it was not till October that it was reported finished and the payment then due requested. The influence of temperature on its figure was now quite perceptible. In the evening, while temperature was falling, the defect of spherical aberration was one way, but after it became stationary, the defect was slightly in the opposite direction.

The telescope is by no means finished with the glass. The latter must be carried in one end of the tube, as large as a good-sized steam-boiler, and this tube must admit of being pointed with ease and celerity in any required direction. The observer must be able to tell, at any moment, the direction in which it points with extreme precision. It must admit of being moved by clockwork in such a way that as the earth revolves from west to east, the telescope shall revolve from east to west with exactly the same velocity, and thus point steadily at the same star. The details of the machinery for attaining these and a multitude of other objects have required a large amount of thought, contrivance, and calculation, and it is only after the expiration of another year (1873) that every thing is complete.

The construction of a building in which a telescope is to be placed is second in importance only to that of the instrument itself, from the fact that defects in the structure may seriously interfere with the efficiency of the instrument. The total cost of the tower, dome, and foundation for the instrument, including three rooms for the use of the observers, was about $14,000, and the price of the instrument itself being about $48,000, the entire cost of building and telescope will be about $62,000. One or two thousand more may be expended in completing all the arrangements, but this will be all. (117)

A PATENT TICKET INDICATOR.

A NOVEL apparatus has just been patented which is intended to receive the tickets and conductors' checks of railroad-passengers, indicate the destination of each traveler while he is in the car, and keep a record of all the trips made, inaccessible to any trainman, or to any one except the proper agent—presumably a representative of

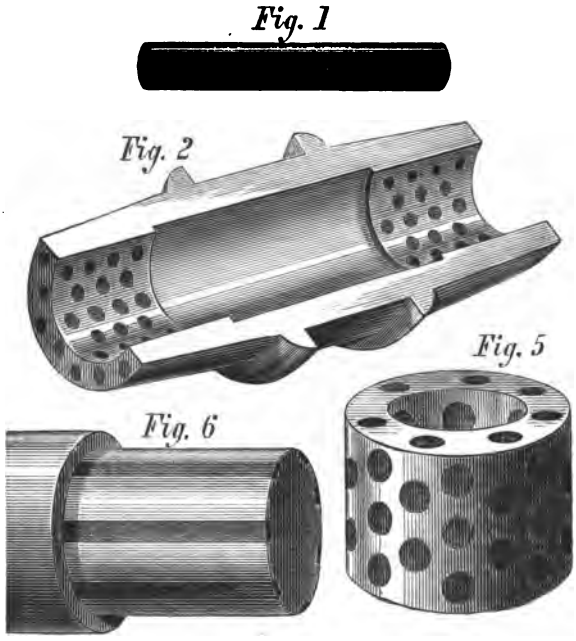
the General Ticket Agent, at the end of the trip. For this purpose there is fastened a box with two compartments on the side of the car above each seat, there being one compartment for each passenger. When the conductor takes up a ticket, or collects a cash fare, he punches the ticket or the check which he gives for the cash fare and slips it into the mouth of the compartment which answers to the passenger's seat. The box contains a simple apparatus which conducts this ticket to a plate inclined a little from the perpendicular, on which it rests, plainly visible through the glass face, and showing the stations from and to which the passenger is entitled to ride. After being put in, it can not be touched, and if a passenger is inclined to ride further than he has paid, the ticket over his head will show plainly and unquestionably his proper destination. When he gets out, and a new passenger takes his seat, the entering of the latter's ticket causes the former's to drop into a lower compartment, while the one last received remains in the upper.

METALINE.

THIS is the name given to a dry lubricating compound, the invention of Stuart Gwynne. It is intended for use in lieu of oil. It is a dark-colored soft material, of which the basis is a white and brittle alloy, to which, when ground into an impalpable powder, other components are added in quantities in direct proportion to the degree of hardness desired. Plumbago is one of these components. The mixture completed, the substance, still in a dry powder, is placed in suitable moulds, in which, under a pressure of hundreds of tons per square inch, it is made into small cylinders, one of which in full size is shown in Fig. 1. The remainder of our engravings represent various modes in which the metaline is applied. The general plan, as shown in Fig. 2, is to bore into the inner periphery of the journal-box a series of shallow cavities, into which little plugs of metaline are fitted. The two parts of the bearing are brought together, set upon end, and a reamer, forced down through the opening, pares off the projecting and irregular portions of the plugs, leaving the interior surface perfectly true and smooth.

In Fig. 3 is represented a bearing, part of which is cut away to show the manner of introducing the metaline, in section. At A, in the same figure, is a collar, which revolves with the shaft, and of course rubs against the edge of the box; the manner of providing against friction by a similar arrangement of metaline disks, as already described, is here indicated, the plugs being inserted direct-

ly in the sides of the collar. Fig. 4 shows how the metaline is applied in cases where the inner periphery of the bearing is inaccessible. A collar, Fig. 5, of suitable size, is made and fitted with disks as represented, and inserted in the bearing, which is suitably enlarged to receive it. This proceeding is applicable to very small shafts, as mill-spindles, etc. In certain cases where it might be preferable to avoid altering the bearing, the shaft is slotted and

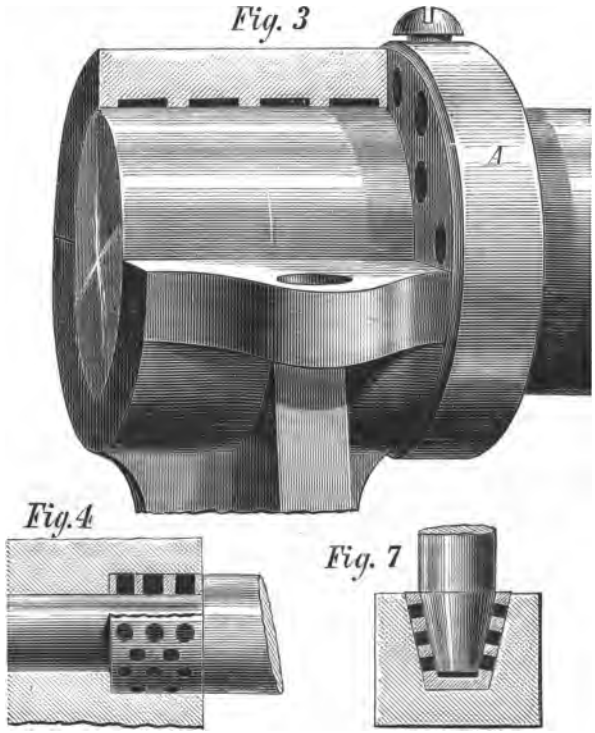


METALINE—METHODS OF USE.

the metaline forced in under strong pressure, in the positions depicted in Fig. 6. Lastly, Fig. 7 represents a step for a mill-spindle or any upright swiftly rotating shaft, notably of the kind used in supporting the cutter heads in wood-working machinery. Here a conical cup of brass is fitted with plugs as shown, and secured in a suitable cavity in the heavier portion. The mode of application must necessarily vary greatly with the construction of the

machine, and other attending circumstances; and we may add that many varieties are made, to adapt the material to different speeds, pressures, weights, etc.

At the workshops of the American Metaline Company, No. 61 Warren street, New-York, various kinds of experimental machines may be seen in motion, and, among others, there is a mill-spindle, rotated at the rate of 8000



METALINE—METHODS OF USE.

revolutions per minute. The shaft is of steel and the bearing is of similar metal, fitted as closely as can be done. Metaline is introduced in slots in the shaft. We examined the apparatus carefully, and could detect no heating. Four sewing-machines are also continuously running at full speed, the needle-bars of some at the rate of 1200 revolutions per minute. No oil or other lubricant but

metaline is in use, and there is clearly no cutting or heating. A five-horse-power Baxter engine we also found running, at the rate of about 150 revolutions, and we were informed that it had been daily in use for over six months without the application of oil to any of its parts. Our attention was also called to the countershafting in the machine-shop, the journals of which had been cut down to a length equal to one diameter of the shaft, as shown in our engravings, Figs. 2 and 3; and such indeed was the case with all the journals to which the metaline had been applied. The pins of the drawbridges of the Central Railroad of New-Jersey, over the Passaic and Hackensack rivers, were fitted with metaline three years ago, and, as we are informed, now exhibit no signs of wear. Specimens of brasses and also of shafting shown to us, which ran for a continuous period with the lubricant, appeared to be perfectly smooth and polished like a mirror; while judging from our examination of machinery which had been in actual motion for several months, there seemed to be no working up of the substance; and so far from there being any dirt in the bearings, the revolving shafts barely soiled a white handkerchief.

SMALL FAST STEAMERS.

MESSRS. J. I. THORNEYCROFT & Co., of Chiswick, Eng., have built a number of vessels of this class, one of which, the Firefly, made 18 miles per hour. Her dimensions are: Length over all, 53 feet; breadth, 6 feet 6 inches; draught, 2 feet 6 inches. Inverted direct acting engines, two cylinders, 6 inches diameter, 8 inch stroke. After the trial, this boat was coaled and lifted on board a steamer for Ghent, Belgium, where on arrival she was lowered again into the water, fire lighted, and she steamed off to her destination near Ghent.

NEW BRITISH WAR STEAMER.

AT Chatham, England, was lately launched the Raleigh, a ship built, not to offer great resistance to shot and shell, but with a view to combine great speed with a heavy armament. She is built of iron, sheathed with wood and coppered, and lined with brown cardboard, as being less likely to splinter, and also less inflammable than timber; and her dimensions are: Length, 298 feet; breadth, 48 feet 6 inches; draught of water forward, 20 feet—aft, 23 feet; tonnage, 3210 tons; armament, upper deck, two 12½ ton guns, four 64-pounder guns—main deck, fourteen 90 cwt. guns, two 64-pounder guns; horse-power, 800; crew, 530; estimated to cost, when finished, about $1,000,000.

UNDERGROUND RAILWAYS IN AMERICA.

THE city of Baltimore now boasts of the possession of a splendid underground railway, the first ever constructed in this country. From all accounts, the new works are highly creditable to the city and the enterprising individuals under whose auspices they have been executed. Two distinct lines of tunnels have been made at Baltimore, at an expense of some five millions of dollars, whereby nearly all of the various railways now centring in the city have their tracks united. The conveniences of the public and the mercantile facilities of the city are thus greatly improved.

The Underground Railway consists of the Baltimore and Potomac tunnel, of which the western portal fronts on Gilmore street, whence it extends in a northeasterly direction through the city, under some twenty-nine streets and avenues, emerging at North avenue, where it joins the track of the Northern Central Railway.

The Union Tunnel extends, from tide-water at the Canton portion of Baltimore, northerly and then easterly, under some thirteen streets and avenues to the Northern Central Railway.

The total length of the Baltimore Underground Railway is 3½ miles, of which about two miles are closed tunnels, and the remainder open cuts, over which the streets are carried on bridges.

The tunnel arches are from 22 to 23½ feet high and from 26 to 27 feet wide, five rings of brick thick, backed with rubble masonry. Only a portion where the ground was soft and springy required the invert arch. The springs of the arches are of masonry.

The Baltimore Underground Railway passes through the finest section of the city, where the people of wealth and fashion reside; but no one is disturbed, and the streets and avenues are not in the least interfered with.

It will be remembered that the Legislature of this State, session of 1873, granted a charter for an underground railway in this city, to extend from the Battery under Broadway to Central Park, a distance of five miles, with a branch under Madison avenue to Harlem River, a distance of six miles additional—eleven miles in all. The soil is admirably suited to the work, while the route is almost a straight line. This road will doubtless enjoy the largest and most remunerative traffic of any city railway in the world, as it passes directly under a thoroughfare which is at once the business heart of the city and the central line of travel. Arrangements for the construction of this road are now in progress.

THE BROADWAY UNDERGROUND RAILWAY, NEW-YORK.—INTERIOR OF THE BLEECKER-ST. STATION.

THE BROADWAY UNDERGROUND RAILWAY, NEW-YORK.

PROBABLY no city in the world offers so many facilities for the local movement of its people as London, and to this, doubtless, is due her steady growth, her enormous population, her marvelous enterprise and wealth. London numbers at the present time four millions of people. She supports twelve thousand cabs, besides omnibuses, railways, and elevated railways; but the crowning advantage of London, so far as rapid transit is concerned, is in her splendid system of *underground railways*. These magnificent works, built regardless of expense, ramify in every direction under the streets, ascending the steepest grades, turning the sharpest curves, uniting all the principal centres of business, railway-stations, and public places. Step on board the underground railway-car, and one may be carried, almost in the twinkling of an eye, to or near any desired point in the English metropolis. Last year, nearly sixty millions of passengers were carried on the London underground railways. Commenced about fourteen years ago, with a length of only 3¼ miles, they have been steadily extended, until their existing length is over twenty miles; and they are being annually increased. Other forms of locomotion tend to obstruct and blockade the streets; not so the underground railway. Placed below the surface, it is readily extended in any desired direction, while its operation interferes with no other traffic and creates no noise or nuisance to inhabitants along the line.

For the purposes of rapid transit in large cities, the underground railway is preëminently desirable. In this country during the past year, an underground railway has been finished and opened in Baltimore. At St. Louis, the construction of an underground railway is now in rapid progress. At Constantinople, the underground railway is nearly completed. Last, but not least, comes the city of New-York. Among the important engineering works authorized in 1873 is the Broadway Underground Railway, the scope of which embraces the extension of railways underneath the principal streets and avenues of the city, offering the most abundant, permanent, and economical means for the rapid and easy transport of passengers and freight.

Our engraving shows the interior appearance of one of the Broadway Underground Railway-stations, designed for location at or near the junction of Broadway and Bleecker street, and conveys a general idea of the substantial and splendid character of the works which

it is the aim of the company to construct. This station is to be 250 feet in length. It will occupy the entire width of the street under Broadway, the street being supported by the roof of the station which rests upon elegant Corinthian columns, as shown. The whole interior of the station will be brilliantly flooded with light in the day-time by means of the improved glass and iron sidewalks. This station may be regarded as a type of many others that will be required along the route, which by their ornamental finish, spacious proportions, and convenience of access, will assist to render the Broadway Underground Railway an attractive and popular avenue for rapid transit. The main route is from the Battery, at the extreme southerly end of the city, directly under Broadway, to its junction with Eighth avenue at Fifty-ninth street, the southern boundary of Central Park.

At Twenty-third street, it will have a branch line from Broadway to and under Madison square and Madison avenue to Harlem River, and under that river terminating on its northern shore. This distance is eleven miles. The Board of State Engineers, under whose direction the road is to be built, are as follows: General George S. Greene, Allan Campbell, and James P. Kirkwood. All these gentlemen are civil engineers of eminence, in whom the public have entire confidence.

Mr. A. E. Beach, one of the editors and proprietors of the *Scientific American*, New-York, is the President; Mr. Joseph Dixon, so long and favorably known for his untiring labors in promoting the underground railway system in this city, is the Secretary of the company.

For the purpose of accommodating the working classes, Gov. Dix, before signing the bill, required that the rate of fare should be fixed at eight cents between five and seven A. M. and five and seven P. M. At other times, it may be ten cents. The estimated cost of the first section of the road from the Battery to Grand Central Depot is £2,000,000.

Those who are not familiar with the local affairs of New-York will be interested in glancing at the history of this company, noting the energy and success with which it has overcome the many difficulties that it has been compelled to encounter.

The original charter was granted in 1868, authorizing the laying of small tubes for freight. Under this act, the Beach Transit Company was duly formed. To demonstrate the practicability of tunneling Broadway, without injury to buildings, the members of the company built the experimental tunnel now existing under Broadway, from Warren to Murray street.

During the course of this construction, the members of the notorious Tammany ring and others endeavored to stop the work by applying for an injunction in the Supreme Court. This subjected the company to delay and expense; but the decision resulted in favor of the company, when they proceeded with the work. Within this tunnel, they laid a track, and for three years operated passenger-cars by the pneumatic method. Members of the Legislature, public officers, the press, and the public generally, visited the works, rode in the cars, and greatly approved the plans. The company applied to the Legislature for leave to enlarge and extend their works. Few applications for legislation have ever been more fully approved by the people or more unanimously urged by all classes. Public meetings were held under the auspices of the most prominent citizens, and committees appointed to go specially to the Capital to urge the necessity of the work and the importance of encouraging its progress.

In 1871, by an understanding had with Sir Charles Fox & Sons, from five to seven millions of the capital was to be raised in London, if the charter should be granted. The company's new charter passed the Senate in 1871 by a vote of 22 to 5, and passed the Assembly by a vote of 102 to 9, but was defeated by veto of the Governor (Hoffman) on account of alleged engineering difficulties at the crossing of Canal street and Broadway. This veto was read with surprise by intelligent engineers, especially in London, where the underground railway system has been successfully carried through places which, in respect to difficulty of execution, remarked Mr. Douglas Fox, C.E., "dwarfs into insignificance any thing that can be encountered in New-York."

In 1872, the company renewed its application to the Legislature, and the charter was again passed by the Senate and Assembly by still larger majorities. Again it was vetoed and lacked only one vote of the required two-thirds to pass it over the veto. The company was now condemned to another year of delay, and the disadvantage of discouragement among their financial friends.

In 1873, the company again renewed their application to the Legislature, and at last their efforts, so long and perseveringly continued, were crowned with success. Their charter passed the Senate with only three dissenting votes, and passed the Assembly unanimously, not a single adverse vote being cast.

The announcement was received with great satisfaction by the people of New-York. The Board of Aldermen immediately passed resolutions commendatory of the work,

and appointed a special committee of three members to wait on the Governor to request his immediate approval of the bill. As showing the confidence of the community in the company's work, we quote from these resolutions as follows:

"BOARD OF ALDERMEN, April 7, 1873.

RESOLUTIONS.

"*Whereas*, the necessity for rapid transit from one end of the city to the other is a matter in which all classes of our citizens are agreed; and,

"*Whereas*, the bill authorizing the Beach Pneumatic Transit Company, from the Battery to Harlem River, having passed both branches of the Legislature; . . . and,

"*Whereas*, the passage of the law is likely to prove of great importance to the people of New-York, promoting the convenience and prosperity of all classes of citizens, augmenting the value of property, and increasing the taxable resources of the city; therefore,

"*Resolved*, That a committee of three be appointed to wait on the Governor, and respectfully request him to give his immediate approval to the Beach Pneumatic Transit Bill." . . .

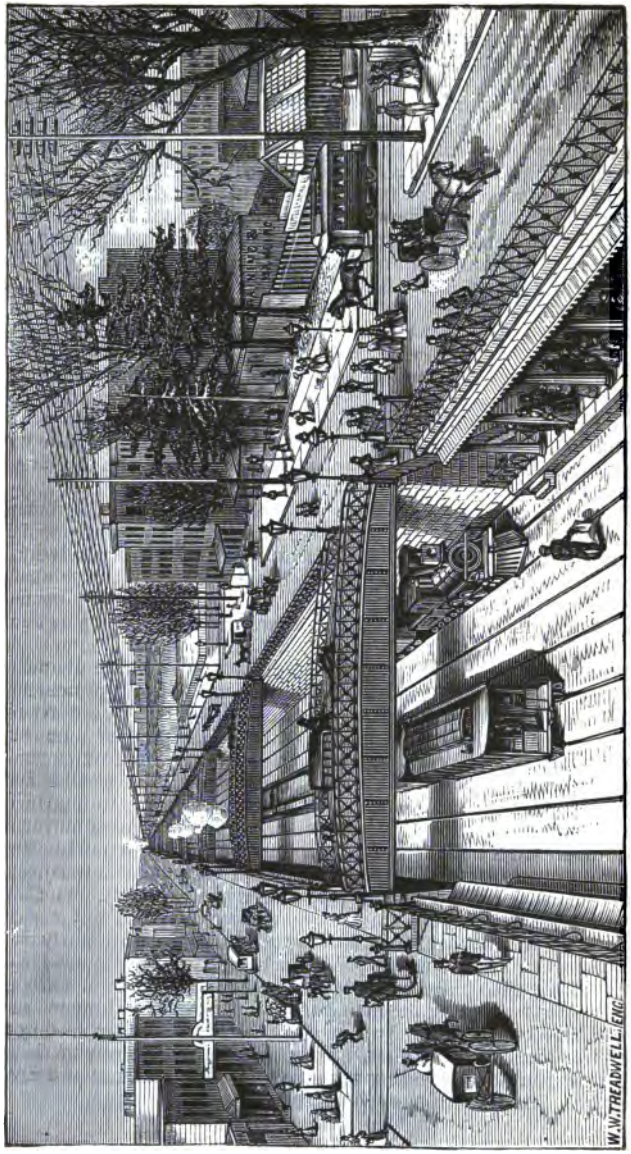
Two days afterward, the Governor, Gen. John A. Dix, on the 9th of April, 1873, signed the charter, and it became a law.

On the grant of its new charter, the company immediately began active operations, in accordance with the new conditions imposed upon them by law. One of these required that the entire capital of the company should be subscribed *bona fide*, and ten per cent in cash paid in before any portion of the works could be begun. The method of propulsion and construction was also made subject to the approval of a Board of State Engineers. New surveys, estimates, and methods of construction were now rendered necessary. Efforts for stock subscriptions and loans were also begun both at home and abroad. It is well known that American enterprises have for years past relied upon English or German capital to assist in carrying them on. A large majority of our railway and mining companies are thus assisted. The agent of the company went to London with plans and specifications, prepared to conclude the previous financial understanding. Sir Charles Fox & Sons, on their part, were as ready as ever to carry out their portion of the work; but the other parties on whom they relied to become associated with them had now undertaken extensive works. Other parties were applied to, and negotiations for the supply of £2,000,000 would

no doubt, have succeeded but for the interference of the agent of a large American railway corporation; this caused a delay, and before the status could be resumed the great financial panic of 1873 burst upon the commercial world, bringing ruin upon many of the most eminent houses, paralyzing industry and business, and compelling the postponement of the company's supply of means.

So pressing is the need for rapid transit in New-York, that many citizens have become desirous that the municipality should, under proper safeguards, now lend assistance toward the completion of this road. By the authority of the Legislature, the cities of New-York and Brooklyn are authorized to assist the construction of the great suspension bridge, thus promoting rapid transit between the two cities. Several millions of dollars have been thus expended, and the wisdom of the measure is very generally conceded. By authority of the Legislature, the city of New-York is now also contributing, by direct payment of money, to a large amount, toward the reconstruction of the Harlem Railroad by placing the tracks below the surface of Fourth avenue. No one questions the expediency of this measure. There are abundant precedents to warrant the popular feeling that the aid of the city ought to be extended to the Broadway Underground Railway. All the money needed can, it is said, be had at thirty days' notice, on condition that the city will guarantee the company's bonds to the amount actually expended upon the first section of the road.

It is generally conceded that as a property, the Broadway Underground Railway, when it goes into operation, will be of permanent value as an investment, and that if the suggested guarantee were given, the city would never be subjected to loss or called upon for money. The capacity, patronage, and resources of the road would be more than sufficient to meet the interest and principal of its bonds. But for the sudden and overwhelming financial revolution of the past year, the company would have had several thousand men employed at various points upon its line, and the winter of 1873–74 would have seen the main portion of the first section under full headway. At Forty-second street, the Broadway Underground Railway will connect with the Harlem, Hudson River and New-Haven Railways, and by pushing forward the construction of this first section, the citizens of New-York may soon have a complete line for rapid-transit cars from the City Hall to Harlem and Westchester; and the success of this line will unquestionably lead to the construction of new lines as fast as they may be needed.



THE FOURTH AVE. IMPROVEMENTS.—NEW-YORK AND HARLEM RAILWAY.

THE RECONSTRUCTION OF THE HARLEM RAILWAY, NEW-YORK.

FOR many years, the New-York and Harlem Railway-trains have entered the city on tracks laid for the most part on the surface of Fourth avenue. The steady increase of population and the augmentation of trains upon these tracks made it necessary either that the railway should be removed from the avenue, or some means devised for the protection of the lives of citizens. Besides the Harlem trains, the passenger-trains of the New-York Central and the New-York and New-Haven railways use this route, and there is a constant procession of locomotives in both directions, rendering the crossing of the tracks at all times dangerous. The Legislature appointed a board of engineers, consisting of Allan Campbell, Alfred W. Craven, the chief engineer of the Department of Public Works, and the engineer of the Harlem road, who were charged with the preparation of suitable plans, and the execution of the same, at the joint expense of the city and the Harlem Company.

The work is now progressing satisfactorily, and is being executed in a very substantial manner. The entire width of the avenue is 120 feet, of which 60 feet are occupied by the company's works. From Forty-fifth to Forty-ninth streets, the whole width of the avenue is occupied by the tracks, bridges with inclined planes at the ends being extended from the intersecting streets over the tracks. At Forty-ninth street, the track descends below the grade of the street into an open cutting which is walled, parapeted, and inclosed by railing, and is bridged at the street-crossings. At Fifty-ninth street, the tracks enter tunnels, which extend to Ninety-seventh street. The low ground from Ninety-seventh to One-hundred-and-sixteenth street is crossed on stone arches, the cross streets running through the arches below the tracks. For the remaining distance to Harlem River extends an open cutting like that first described. On each side of the cut a roadway 25 feet wide is left, and a sidewalk of fifteen feet. The law provides that whenever the company pays out $25,000 on the work, the Comptroller shall hand one half of that amount to the company. Under this law, the city treasury has up to this time supplied some two millions of dollars, which is to be reimbursed to the city by a special tax upon the real and personal property of citizens. When finished, the reconstructed railway will have four tracks from Harlem River to Forty-second street. Way-stations are provided, and two tracks will be used for way-trains.

BOTANY AND HORTICULTURE.

THE COCOA-NUT PALM.

THIS valuable tree yields most of the necessaries of life to the natives of the countries in which it grows. It flourishes in all tropical regions, being generally found near the coast, or on the larger streams. The stem or trunk is cylindrical, attains a diameter of about two feet, and a height of from sixty to one hundred feet, bearing at the top a crown of from sixteen to twenty leaves, which usually curve downward, and are from twelve to twenty feet in length. The flowers proceed from within a large pointed spathe; the fruit grows in short racemes, which bear, in favorable situations, from five to fifteen nuts. Ten or twelve of these racemes in different stages may be seen at once on a tree, about eighty or a hundred nuts being its ordinary annual product. The tree begins to bear fruit when about eight years old, and continues productive for seventy or eighty years.

All parts of the tree, from roots to fruit, are variously serviceable to man. The root possesses narcotic properties, and is therefore sometimes chewed. When the stem is young its central part is sweet and eatable; but when old it is a mass of hard fibres. The wood is useful for building, and is largely consumed for this purpose. That of the lower part of the stem is very hard, takes a beautiful polish, and is employed in a great variety of ways. Under the name of *porcupine wood*, it is used in ornamental joinery work. The fibrous centre of the old stems is made into cordage. The dried leaves are much used for thatch, and make an excellent roof. Baskets, mats, screens, etc., in endless variety of pattern, are made by plaiting together the leaflets; and in the hands of the South-Sea Islanders the stretched fibres of the leaves make excellent strings for the Æolian harp. The midribs of the leaves supply the natives of tropical coasts with oars.

The food products of the tree are even more numerous and important. The saccharine sap is an esteemed beverage in tropical countries; and exposed to the sun for a few hours, it ferments and forms what is known as palm-wine. The spirituous liquor, *arrack*, is obtained from this by distillation. If the fermentation of the sap is allowed to continue for one or two days, a very good vinegar is the result. Boiled down, the sap also yields a kind of sugar called *jaggery*. The terminal bud, known as *palm cabbage*,

is considered a great delicacy, and the trees are often cut down to obtain it. The fruit or nut, when young, is filled with a pleasant milky fluid, of which the natives are very fond; it is also used in the preparation of curries and various other dishes. When ripe, the kernel contains some seventy per cent of a fixed oil, which is obtained by pressing the bruised kernel, or by boiling over a slow fire, the oil being skimmed off as it floats on the surface. A quart may be thus extracted from seven or eight cocoa-nuts. At the ordinary temperatures of tropical countries, this oil remains liquid, but in colder climates it becomes solid, and takes the name of cocoa-nut butter. The oil is an important article of commerce, being much employed in the manufacture of stearine candles, and also of a marine soap, which forms a lather with sea-water. In tropical countries, and especially in the East, it is much used as a lamp-oil, and is also employed as an article of food, so long as it remains sweet; it is, however, very liable to become rancid. Cocoa-nut oil is not to be confounded with palm-oil, which is the product of a different tree, the *Elais guineensis*, and kindred species, on the western coast of Africa near the Equator.

The shell of the cocoa-nut is made into cups, goblets, ladles, and other utensils, and is susceptible of a very fine polish. The fibre that envelops the nut is used in preference to tow for caulking vessels, as it does not rot in the water, and swells in imbibing it. Out of it, also, excellent string and all sorts of cable and cordage are manufactured.

THE LACE-BARK TREE.

THE lace-bark tree of Jamaica is worthy of a place among the curiosities of the vegetable world. Its bark consists of a number of concentric layers, each layer being formed by the interlacing of fine, strong fibres in every direction. By macerating the bark in water, these layers are separated, when each one has an appearance closely resembling that of lace. "The ladies of Jamaica," writes a traveler in that island, "are extremely dextrous in making caps, ruffles, and complete suits with this material." It is bleached by being stretched in the sunshine, and frequently sprinkled with water. It bears washing extremely well with common soap, and acquires a degree of whiteness equal to the best artificial lace. There is no doubt but very fine cloths might be made with it, and perhaps paper. The negroes have made clothes with it of a very durable nature. The common use to which it is at present applied is rope-making. The Spaniards are said to work it into cables, and the Indians use it in a variety of fabrics.

It is also employed for making horse-whips, and previous to emancipation, lace-bark whips were employed in flogging negro slaves. To make a whip, a twig or stick of suitable thickness is selected and cut of the required length; then a portion of the bark is loosened, beaten into fibre, and stripped down toward the thick end, where a portion is left for the handle. The fibre is then plaited and forms a very good thong.

THE POTTERY TREE.

AMONG the many wonderful vegetable products of Brazil, the pottery tree of Para is not the least worthy of note. This tree, the *Moquilea utilis* of botanists, attains a height of one hundred feet before sending out branches. The stem is very slender, seldom much exceeding one foot in diameter at the base. The wood is very hard, and contains a large amount of silica—not so much, however, as the bark, which is largely employed as a source of silica in the manufacture of pottery. In preparing the bark for the potter's use, it is first burned, and the residue is then pulverized and mixed with clay in varying proportions. With an equal quantity of the two ingredients a superior quality of ware is produced. It is very durable, and will bear almost any amount of heat. The natives employ it for all manner of culinary purposes.

When fresh, the bark cuts like soft sandstone, and the presence of the silex may be readily ascertained by grinding a piece of the bark between the teeth. When dry, it is generally brittle, though sometimes hard to break. After being burned, if of good quality, it can not be broken up between the fingers, a pestle and mortar being required to crush it.

THE SACK-TREE.

A NOTABLE tree is the *Antiaris saccidora*, or sack-tree, of Western India, the inner bark of which forms a very good material for sacking, and also for cordage. It often attains a height of 100 feet, with a diameter of six. The native method of making sacks of this material is very simple. Usually a tree about one foot in diameter is chosen, and from this a section of the length desired for the sack is cut. This log is steeped for some time in water, in order to soften the bark, and is then beaten all around with clubs. In this way the outer bark is removed, and the inner detached from the wood, and rendered soft and pliable. Next it is folded over on itself at one end, after the manner of skinning a squirrel, and so turned inside out. All that is now required to complete the sack is, that one of the ends be sewed up, which is readily done. But a sack may be made

without stitch or seam. This is done by arresting the process of *skinning* some two or three inches above the farther end of the log, and then sawing off the latter at that point. The sack has then a solid wooden bottom.

These sacks are extensively used in Western India and Ceylon, and serve their purpose very well. The same material is sometimes employed in the manufacture of clothing, and for paper-making. To prepare it for the former purpose, the bark is stripped off in pieces, which are then thoroughly soaked and beaten out till the texture becomes white and rough like fur. It is then cut according to the required shapes, and stitched together.

INFLUENCE OF COAL-GAS ON TREES.

IN the botanical garden of Berlin, a maple and a lime tree, 3⅛ to 5½ feet in diameter, were treated daily, from July, 1870, for six months, with 100 cubic feet of gas, introduced 2½ feet under the surface of the soil, and about 3 or 4 feet from the trees; they began to look sickly after a month's exposure to the action of the gas; the maple died in the following spring, and the lime in the summer. An examination of the roots showed that the poisoning begins at the growing ends of the roots, and that the bark of the roots is not acted on. In another experiment, 25 cubic feet of gas were daily passed into a plot of ground having a surface of 144 square feet, and on which twelve young trees had been growing for one and a half years; the trees showed signs of poisoning in a week's time, where the surface of the soil had been firmly stamped down, and in a month all the trees had lost their leaves.

ACTION OF SALT ON TREES.

DR. KEDZIE, of the Michigan Agricultural College, gives the following account of the injurious action of salt on trees: "On the college-grounds there formerly grew a fine, vigorous specimen of common sassafras apparently in perfect health. A quantity of strong brine was inadvertently thrown beneath this tree, forming a stagnant pool in its immediate vicinity. In a very short time the tree began to manifest signs of decreasing vitality. The salt was absorbed unchanged in such immense quantities, that entering the circulation, it effloresced upon the surface of the leaves as a white crystalline deposit, and the tree soon after died."

THE MORTALITY OF TREES.—Late planting, says the *Gardener's Magazine*, is a common cause of tree mortality. It has been well said by a great planter that trees properly planted before Christmas will grow without being looked

at; but those planted between Christmas and Lady-day must be coaxed to grow, while those planted after the last-named date must actually be compelled to grow. In every case of buying and planting, delays occurred that nobody expected, and therefore those who have any serious planting business in prospect should begin early, for in this case it is emphatically true that to win the day we must emphatically take time by the forelock. We should never hesitate to lift any and every kind of tree in October, even if then full of green leaves; but as a rule, November is *the* season for transplanting, for then the sap has done its work, and the sooner the tree is at rest the better. It is important for planters to bear in mind that roots move when leaves are still—in other words, trees make new roots after being transplanted, although they do not push into leaf until their season of leafing returns. All trees grow at the root during winter, and the sooner they are planted the better, because the earth is warm in autumn, but cools down as winter operates upon it, and is injuriously cold for planting in the spring.

THE LEATHER-WOOD.

THE *London Gardener's Chronicle* notices an American shrub, which it thinks is likely to prove valuable for fibre purposes. It is known as the Leather-wood, Moose-wood, Hickory, etc., *(Dirca palustris,)* and is quite plentiful in the mountain regions of the Middle and New-England States. For the benefit of readers unacquainted with its character, we may mention that the young and, in fact, all the branches, are remarkably pliable, owing to the tough, smooth bark, which Indians use for thongs. The wood itself, however, is very tender, when divested of its covering, and is quite white and soft. It is a handsome globular bush of medium size, and has small clusters of yellow flowers which precede the leaves, and are quite ornamental.

THE SILVER THORA.

THE editor of *The Gardener's Monthly* says that the Silver Thora (*Elæagnus parvifolius*) comes nearer filling the requirements for a good hedge than any other with which he is acquainted. The young shrubs have no thorns the first year, and consequently look very harmless, but the multitude of little branchlets harden with age and become tough and pointed, forming in time a sharp and sure defense. The plants when thickly set rarely show any disposition to grow above six or eight feet high. Another advantage is that as they increase with age, the growth appears to be mainly from the bottom, thus continually

thickening up the most desired portion of a hedge. Unlike the osage orange, they form a protective screen without shearing, although greatly benefited by the usual care bestowed in such cases. Great stress is laid upon the beautiful appearance of the plant, its young shoots, as well as the under sides of its leaves, being of a silvery hue; and the berries—which are produced quite numerously—of a showy mottled red in color. The flowers have somewhat the fragrance of the hawthorn, although not attractive in appearance. It has never yet been injured by the winter in Pennsylvania, and therefore may be relied on in that latitude at least. A hedge of it forms a pretty background for smaller plants.

THE ICE-PLANT AND THE OTHONNA.

DR. GEORGE THURBER calls attention to two useful succulent plants. The first, which he terms the Variegated Ice-Plant, is a dwarf, of trailing habit, with creamy white foliage, and forms a conspicuous object for bedding purposes. Flower-lovers are well acquainted with the Ice-plant family, *(Mesembryanthemum;)* and knowing it is to admire the singular yet beautiful crystal-like vesicles which adorn its fleshy leaves. The other is an *Othonna*, or, to give its full title, *O. crassifolia*. This is an old friend in English gardens, but its real use as a bedder has only of late been fully appreciated. As a basket plant, it is said to be remarkably attractive, the long slender stems, with their fleshy leaves, presenting a pretty feature when drooping over the edge. It grows very rapidly, and was tested the past season as a bedder, or, if we may use the expression, a carpeting-plant, for which it also proved admirably adapted. The idea of carpeting arose from the prevalent desire to hide the soil in beds where taller plants are growing.

VEGETABLE IVORY.—The kernel of the corrozzo-nut so closely resembles ivory as to merit the title of vegetable ivory. The plant *(Phytelephas macrocarpa)* which produces this nut belongs to the palm-tribe. It grows in South-America, and possesses extraordinary beauty. The stem is short, and lies along the ground, but from its crown issues a sheaf of light-green, pinnated leaves, like ostrich-plumes, which often attain a height of 30 or 40 feet. The fruit of the plant is as large as a man's head, and contains a number of nuts of rough, triangular shape, each being almost as large as a hen's egg. When fully ripe, the kernel of the nut is very hard and white, and hence the name phytelephas, *(vegetable ivory.)* This is now largely used as a substitute for elephant ivory, in the manufacture of buttons and va-

rious ornaments, and might easily pass for the animal product. Indeed, the best judges are often deceived by the close resemblance between the two. Advantage is taken of this circumstance in Germany by dealers in bone-dust to adulterate their wares with the waste of the factories where the vegetable ivory is manufactured. The best mode of detecting the adulteration is to burn the suspected article. If it contains any considerable amount of the vegetable substance, the application of heat will cause it to give out an odor much like that of roasting coffee; but if it is pure bone-dust, or nearly so, it will emit a nauseous and very disagreeable stench.

SENSITIVENESS IN THE LEAVES OF DROSERA.—At the recent meeting of the British Association at Bradford, a paper was read by Mr. A. W. Bennett, On the Movement of the Glands of *Drosera*. The glands which cover the margin and upper surface of the leaves of the sundew have the power of imprisoning insects that alight upon them by means of a thick viscid secretion which they exude. After the insect has become completely entangled in this secretion, the glands from all parts of the leaf begin to converge toward it, every gland ultimately pointing the knob at its extremity toward the imprisoned insect, which they apparently consume and digest. It appears from a series of experiments made by Mr. Bennett that raw meat is acted upon by the glands of the leaf in precisely the same manner as a fly, though rather more slowly; while a non-nitrogenous organic substance like a piece of wood, or an inorganic substance, undergoes no change. From the time which elapses after the first contact of the insect before any considerable movement of the glands takes place, it seems that it is not due to the mechanical irritation caused by the struggles of the insect.

HYDNORA AMERICANA.—The genus *Hydnora* includes a number of extremely remarkable root parasites; they are with one exception found only in Africa. Two species occur at the Cape; a variety of one of these was met with by Welwitsch in Angola, and a second Angolan species has been recently described by Decaisne (*Bull. de la Soc. Bot. de Fr.*, 28th March, 1873.) Beccari found two species in Abyssinia (*Nuov. Giorn. Bot. It.*, 1871, 5,) while a third from the same locality is described by Schimper. Sabatier also found a species, which Decaisne holds to be distinct, at the sources of the White Nile. In the African type, the staminal column is annular and the placentas are pendulous. In the solitary American species, first discovered in Southern Brazil by Tweedie, the staminal column is

solid, and the ovules are immersed in radiating plates which form parietal placentas. These terminate above in a truncate mass forming the stigma and constituting the floor of the perianthial tube. The fertilization of this extraordinary plant is effected by small beetles, which crawl through three apertures beneath the staminal column, attracted probably by some secretion from the small glandular bodies which stand immediately below them. Robert Brown failing to find pendulous placentas, and not appreciating the complete significance of the radiating plates, described Tweedie's specimen as dioecious, in which he was in error. But a more curious misapprehension of the structure of the plant was fallen into by Mr. Miers, who in the September number of the *Journal of Botany* gives a description of the upper half of a flower collected by himself in 1826 near Buenos Ayres. He regards the glandular bodies above mentioned as the placentas, which in his specimen were really altogether wanting. De Bary has published an account in the main correct of this extraordinary plant in the *Abhand. der Naturf. Gesellsch. zu Halle*, 1868, and at the first meeting of the Linnæan Society, Dr. Hooker gave the results of an examination of the specimen in the Kew Herbarium which had originally been in the hands of Robert Brown. (42)

DIMORPHISM IN FLOWERS.—Dr. Hermann Müller, of Lippstadt, is publishing a series of articles in *Nature* in which he offers a somewhat new interpretation of the different form and color sometimes exhibited by the flowers belonging to different individuals of the same species. He illustrates this especially in the case of three plants: *Lysimachia vulgaris*, *Euphrasia officinalis*, and *Viola tricolor*, in each of which there are two well-known forms, one with larger and brighter, the other with smaller and less conspicuously colored flowers. Dr. Müller shows that they are accompanied by other structural differences, relating especially to the position and arrangement of the stamens and pistil, which clearly point to contrivances for different modes of fertilization; and this again corresponds to differences in the localities where the two forms occur spontaneously. In the case of *Lysimachia vulgaris*, the form with the larger and brighter flowers grows in open, sunny situations, and is abundantly visited by insects, while the form with the smaller, less brightly colored flowers is found in shady situations, where there are very few insects, and is apparently generally self-fertilized.

LIME, salt ,and sulphur are recommended as a superior fertilizer for grapes peaches and other fruits.

PREVENTING MILDEW ON GRAPES.

AT the recent Horticultural Exhibition in Cincinnati, there were shown a few magnificent clusters of Catawba grapes, weighing from 11 to 14 ounces each, and ripened perfectly by covering the bunches during the growing season, some with oil-cloth, some with wax-cloth, and others with paper only, the latter answering the purpose best of all. That this plan is a preventive of mildew, rot, insects, and other ills to which grapes are heir, appeared to be proved by its fruits, which, according to report, could not have been surpassed in the palmy days of this "beauty with the damaged reputation." The method of operation was simple enough: the light-brown paper or other material used was cut into pieces, six to ten inches each way, and early in the summer pinned over the bunches, leaving an opening at the bottom only. It seems not unreasonable to conclude that other grape-lovers of fastidious taste, willing to pamper the capricious Catawba to this extent, might restore her with satisfactory results to her former favorite position in their grounds.

THE BARK-LOUSE.

AT a meeting of the St. Louis Academy of Sciences, Mr. C. V. Riley announced the interesting discovery of the male of the mussel-shaped bark-louse of the apple-tree, (*Mytilaspis conchiformis*, Gruelin,) and exhibited specimens and drawings. This is the insect that produces the so-called "scurvy" on apple-trees, and in the more Northern and Western States has been one of the most injurious of our orchard pests for many years past. Yet, common and injurious as it is, entomologists have been endeavoring in vain for a quarter of a century to discover the male. Recently, in the Northwestern States, which have suffered most from this insect, it has suddenly become harmless, and is fast dying out and being exterminated by its natural enemies, while in that part of Missouri where the male has been discovered it is increasing rapidly. Mr. Riley concludes that organic reproduction is the more normal with this insect, but that, as with the closely allied plant-lice, (aphidæ,) the male element is occasionally required to prevent degeneracy.

FERTILIZER FOR MELONS.

COFFEE-GROUNDS, which are very rich in nitrogen, are said to form an excellent manure for melons. In order to produce the best effect, they should be mixed with the earth which forms the bed, so that they should be well decayed by the time roots begin to develop.

THE KANGAROO VINE OF AUSTRALIA.

THE habits of this giant climber (*Cissus antarctica*) are graphically described by a writer in the *Gardener's Monthly*. He saw one of these vines which was almost seven hundred feet in length, and measured three feet nine inches in girth at the base. It had first infolded in its deadly embrace a tree of considerable size, but this support had died and disappeared, and nothing remained but a spiral column of vine nearly two hundred feet in height, from the summit of which the huge climber had sent out its continuations in a horizontal line for more than one hundred and thirty feet, until it reached a eucalpytus tree. It was the opinion of our author's guide that the trees which had supported it on its way to the eucalpytus had perished by strangulation. He named the vine "the devil's corkscrew." Around the eucalpytus the vine had wound in several coils, and then thrown out a number of stems, which were grasping all the trees in the neighborhood of its line of march.

RIPENING OF GRAPES.

BY E. POLLACCI.—The author has proved, by a comparison of the amount of sugar and of acid in the external and internal portions of the flesh of the fruit, that the part nearest the centre contains more of the acid principle, and is, consequently, the last to ripen. During the ripening, the amount of sugar goes on increasing to a certain point, and then remains stationary, whilst the proportion of acid still continues to decrease, so that the grape must be considered to be ripe—not. as heretofore, when the amount of sugar ceases to increase, but rather when the acidity no longer diminishes. (32)

LAWNS.

F. R. ELLIOTT recommends they be made : A good, deep soil, thoroughly trenched sixteen inches deep, raked down, with every stone removed, and seeded per acre with five bushels of what is generally termed lawn-grass seed. The mixture I would make should be twenty-eight pounds of clean Kentucky blue grass, the same of red top, twelve of white clover, and ten of creeping bent grass, to the acre. In sowing this seed, do it three several times—that is, divide it into three parcels ; sow first, east and west, then rake the ground lightly ; then sow north and south, rake again lightly, not over half an inch deep, with a light steel rake ; then sow again the last third of the seed east and west, and roll it—rake no more, but roll it, first east and west, then north and south, and then again east and west.

ATMOSPHERIC PRESSURE AND VEGETABLE GROWTH.—M. Bert, whose observations upon atmospheric pressure and animal life we have already noted, has been making experiments upon the influence of pressure on vegetation. From these, it would appear that temperature is not the only condition modifying vegetable growth at varying altitudes, but that varying degrees of atmospheric pressure have also a controlling influence in this respect. Some grains of wheat were sown in bell-glasses with all the conditions identical, save that the contents of one glass were subjected to the normal pressure of the atmosphere, those of another to two thirds the ordinary atmospheric pressure, and those of a third to one third the ordinary atmospheric pressure. The first grains sent forth shoots 20 centimetres (7 inches) long, the second 5 inches, and the third did not come up at all. Again, with a pressure of five atmospheres, the plants did not come up, the radicles only having been sent out, and on opening the vase a strong alcoholic odor was perceived, in place of the ordinary acetic odor of putrefying wheat. After a few days a mould made its appearance.

IN a work on the vegetable productions of Norway, Dr. Müller says that in lat. 70 deg. north, common peas grow at the rate of three and a half inches in twenty-four hours of continuous sunlight, and that some of the cereals grow as much as two and a half inches in the same time. Those vegetable secretions also which owe their origin to the influence of the actinic rays are produced in extraordinary abundance, and hence the tint of the colored parts of plants is deeper than in more southerly latitudes. As regards the flavoring and odoriferous matters of fruits, they are said to have greater intensity in the north of Norway than they have farther south, though the case is different for the saccharine properties.

LUMINOSITIES OF FUNGI.—The *Gardener's Chronicle* gives a remarkable instance of the luminosity of fungi. The spawn of some unknown species of fungus, growing on a trunk of spruce or larch, was found to give a perfect blaze of white light along the track where the trunk had been dragged. The light was enough to read the face of a watch, and it continued for three days.

DR. BURDON-SANDERSON, in making some experiments on the electrical phenomena which accompany the contraction of the leaves of the sensitive plant, found the currents produced are subject in all respects to the same laws as those of muscles and nerves.

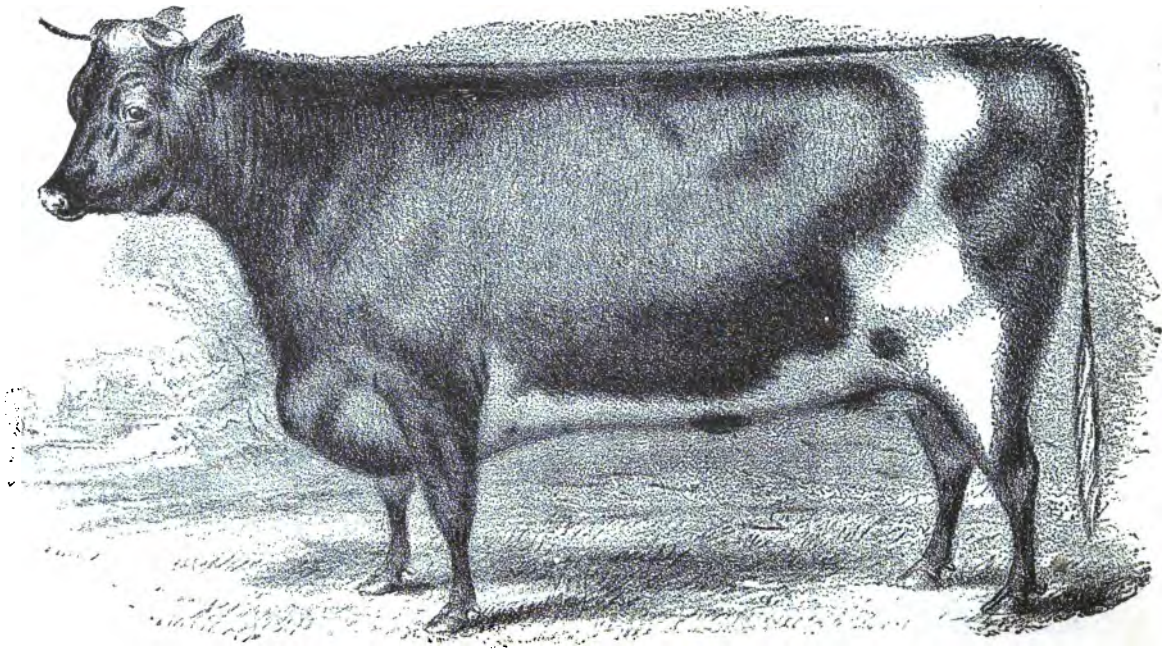
IT is usual to throw away grape-stones as a waste product, or to swallow them when one eats grapes; but it appears that they can be turned to good account. When roasted and ground, they possess an aroma very much like that of East-India coffee, and the beverage obtained therefrom is about the same as coffee in taste, though inferior in quality. An acre of vineyard ordinarily yields 30 to 40 lbs. of this seed. We advise grape-eaters to spit out and save the seeds to make their coffee. The Patent Office has lately granted a patent for persimmon-seed coffee, why not give another for grape-seed coffee?

COLLODION IN HORTICULTURE.—The *Gazette des Campagnes* recommends dipping the end of plant-slips in collodion before setting them out. The collodion should contain twice as much of cotton as the ordinary material used in photography. Let the first coat dry and then dip again. After planting the slip, the development of the roots will take place very promptly. This method is said to be particularly efficacious with woody slips, geraniums, fuchsias, and similar plants.

FROM the investigations of Dr. W. Pfeiffer, it appears that the yellow rays of light possess the highest power of decomposing carbonic acid in plants. The action of the other rays decreases rapidly in proportion to their distance from the yellow in the spectrum; but this decrease is greater in the rays of greatest refraction. Thus, taking the decomposing power of the yellow as 100, that of the green will be 37.2; blue, 22.1; indigo, 25.4; violet, 7.1. On the side of less refrangibility, we have orange, 63.0; red, 25.4.

EVILS OF CHIP MANURE.—Perhaps no greater injury has ever been done in horticulture than the recommendation by inexperienced writers of *chip manure* as a dressing. Its danger arises mainly from its ready disposition to spread fungi, which inevitably arise in soils naturally a little moist and tenacious. When once formed, such fungi spread with astonishing rapidity, totally preventing growth and finally killing the plants. (118)

SOME specimens of plants collected by Dr. Bessels in Polaris Bay, and presented by him to Captain Markham, were recently submitted to Dr. J. D. Hooker for determination, as being the most northern point where any phanerogamous plants were ever secured. The species proved to be *Draba alpina*, L.; *Cerastium alpinum*, L.; *Taraxacum densleonis*, Desf. var.; and *Poa flexuosa*, Wahl.



THE FORTY-THOUSAND-DOLLAR SHORTHORN COW, EIGHTH DUCHESS.

AGRICULTURE AND RURAL ECONOMY.

AMERICAN PROGRESS IN STOCK BREEDING.

IN nearly all matters relating to industrial and material progress, the United States are making unquestionable advance, the basis of which is individual effort. Here every man aspires to better his condition, and tries to attain improvement in whatever his hand may find to do. If a mechanician, he is not satisfied until his devices are made superior to the old-fashioned styles. If a horse-breeder, his mind is given to the raising of a stock that shall beat the world. This pervading spirit of enterprise, this constant study for improvement ramifies into almost every pursuit, and the general result is an elevation of the quality of American productions, which makes them specially sought for in foreign lands.

An exemplification of this is seen in the circumstances connected with a recent cattle sale at New-York Mills, N. Y., near Utica, at the farm of Mr. Samuel Campbell. The animals sold were chiefly of the short-horn variety, imported twenty years ago from England, and since that time subjected constantly to American study and improvement. The result is now seen in the production of cattle of such great superiority that bidders for them have come from distant lands to pay down probably the highest prices ever before given for animals of this variety.

The New-York *Tribune* says that about 500 people were in attendance at the sale, among whom were: the Right Hon. Lord Skelmersdale, whose seat is near Liverpool; Mr. Halford, of Papillon, Market Harborough; Mr. Calthorpe; Mr. Richardson, who represents Sir Curtis Lampson, of Sussex; Mr. Berwick, agent for Lord Dunmore, but who buys for Earl Bective, recently Lord Kenlis, of Underley Hall, Lancashire, and Mr. Kello, agent for Mr. R. Pavin Davis, of Horton, Gloucestershire.

A three-year-old bull brought $12,000. A cow, $30,600. A yearling heifer, $19,000. Another cow, $35,000, bought by Lord Bective. The culmination of the intense interest, however, was reached in the bidding for the Eighth Duchess of Geneva, which was sold to Mr. R. Pavin Davis, of Gloucestershire, Eng., for the unprecedented sum of $40,600. Our engraving is a portrait of this remarkable animal from a photograph. After this, 11 cows of the Duchess family sold for $238,800, an average of over $21,700.

Of these, six went to England at a cost of $147,100, and five remain here at a cost of $91,700.

After the Duchess family came the Oxfords, then the other families, the bulls being brought in after all the cows were sold. There were in all 111 animals presented. The sum realized was $380,890. (83)

ARTIFICIAL MILK FOR CALVES.

SUCCESSFUL experiments have been made in raising calves by means of a soup or milk prepared according to the recipe of Baron Liebig, which is as follows:

Seven pints of water and 3½ pints of milk are boiled with 10 ounces of wheat-flour to an ordinary pap; 3½ more pints of milk are then added, with 1½ ounces of a potash solution, consisting of 2 parts of bicarbonate of potash dissolved in 11 parts of water. The same quantity of bruised malt as of wheat-flour is added to the hot pap, which is well stirred and allowed to settle for half an hour near the stove or other warm place, when it is boiled again and filtered through suitable gauze.

The calves are fed for about six weeks on pure milk, and gradually they are allowed less, some of the substitute being added. At last they are given about 7 quarts of artificial milk per day and no pure milk. After three months, only one half of this quantity is given, ½ pound of linseed-cake being added; in the fall, some boiled potatoes are mixed in. The calves gain about 2 pounds in weight per day. A calf which was weaned on February 22d gained, on an average, 2.12 pounds per day. Should calves dislike to take the milk of the cow, the substitute is given immediately. No disadvantageous effects of feeding with this milk were observed. Diarrhœa did not occur at all. The milk was also applied to the raising of pigs, and was in their case useful in the cure of diarrhœa, which so often fatally attacks them.

A CATTLE-DISEASE, of so disagreeable a nature that it causes the animals affected by it to commit suicide, has broken out on the Asiatic shore of the Bosphorus, and has been officially reported at Constantinople. It is characterized by frothing at the mouth, running from the eyes and nose, a total loss of appetite, great heat, and a thirst so insupportable that some of the beasts attacked by the illness cast themselves headlong into adjacent rivers and streams, and are drowned. The disease has been in existence for upward of a month in several villages on the Upper Bosphorus and Scutari. It attacks bullocks and cows exclusively.

EDUCATION OF HORSES.

RUNNING is undoubtedly the horse's natural gait, as it is his swiftest; but for carriage-driving, and for the thousand and one business purposes for which the horse is used, trotting horses are far superior, and running horses almost useless. Probably this fact first brought the trotting horse into such universal favor, for, before the use of carriages became general, the gait was almost unknown. Since their introduction, however, it has become the universal gait, so much so, in fact, that even on the race-course it predominates, and a majority of the fall meetings in this country are devoted to trotting matches, with occasional running matches sandwiched in between, just for the excitement of the thing. Besides these two distinct gaits, there are several modifications, to some one of which occasional horses are addicted. Thus Pocahontas, one of the fastest horses this country has ever produced, was a pacer—that is, stepped with fore and hind foot on the same side together, or, as old horsemen generally say, "stepped all on one side." Other nags have a habit of swinging their feet in and out, or racking, giving their bodies a motion something like that of a ship in a heavy swell. Others still have a mixed gait. Some trot squarely with their fore feet and run behind. Others have an uneven step, half way between a trot and a run, the legs neither moving together nor shooting out together at exact intervals. Of this latter class was Flora Temple, who trotted a mile in 2:19¾, when tracks were some seconds slower than they are now. All of these gaits, however, are simply imperfect approximations to the trot, the ideal of which is an alternate, accurately-timed stepping; the body swaying neither to the right nor the left, and with the least possible motion up and down. This latter motion is one of the most common faults of the trotting horse, and, when an animal is free from it, he is said to "trot level." Another common failing is a dragging of the hind legs, especially noticeable when the trotting horse begins to tire. As running is the natural gait, most horses take to it without difficulty, and the main differences in the gait are in the length and rapidity of the stride. Most of the great trotters began their trotting education after they were well matured. The record of these best animals also goes to show that, so long as they are sound and their joints limber, they have continued to improve with age, and have done their best work between the ages of ten and fifteen, and generally after they were twelve years old. The cause of this is twofold, and is found in the fact already stated, that the trot is a forced gait, and therefore always

susceptible of improvement; and in the other fact, that the trotting muscles harden with age and get that steely quality that never tires, and enables the horse to hold his gait through the number of heats needed to win a race.—*Springfield Republican.*

HOW THEY CATCH MUSTANGS.

THE editor of the Pleasanton *Stock Journal* gives the *modus operandi* of capturing wild horses in Texas, which will no doubt prove instructive to many. It will be perceived that all the popular notions, in which the lasso and fleet-footed charger play an important part, have little foundation in reality.

As soon as a herd of horses is discovered, the party of hunters divide, one portion striking camp, while the other sets off in pursuit of the herd. The frightened animals go bounding across the prairie through the prickly pear and dense chaparral, leaving a trail which the hunters steadily pursue at an easy gait until they come in sight of the herd, which scampers off as before. These tactics are kept up by pursuers and pursued for days, the mustangs returning to their first starting-point—which they are sure to do—when the camping party takes the place of the tired pursuers, and thus follow the herd, until the poor, wearied, half-starved creatures, with swollen and bloodshot eyes, give up the struggle and submit to be driven anywhere. The object of the hunters has been merely to keep close enough to the mustangs to prevent them grazing. Starvation soon brings them to terms, and the prairie monarch, with drooping crest and dejected look, leaves his native wilds, henceforth to become the slave of man. That is what hunters call, "walking mustangs down."

GATHERING AND TOPPING ROOT CROPS.

BY P. T. QUINN.—Carrots, beets, parsnips, and turnips are now very generally cultivated in rows, by those who raise any or all of the kinds enumerated, to any extent. When the time arrives for pulling, each man or boy takes two rows and pulls them, and as fast as pulled they are placed in one row, side by side, one deep, and in the same relative position. The next two rows are pulled and placed in the same way, with the roots of row number two facing those of number one. By following this plan with every four rows, the labor of gathering the roots, when topped, will be found much less. The main point to be carried out, in pulling and placing turnips or other kinds of roots, is to be sure and keep the necks as near in a straight line as possible. With an hour's practice, a man can pull and

place the roots in this position about as fast as throwing them in heaps. One active man will cut off the tops as fast as two men can pull. Equipped with an ordinary table-knife, the boy follows the puller, severing each top in turn, and frequently two at once, without removing the roots from the position in which they are placed by the men pulling, so there is no time wasted in taking up or throwing down the turnips, beets, or carrots. The topper keeps constantly moving along the line of each row cutting off the tops, as he walks along, being forced to make enough of motion to keep warm even on a cold day. I have topped sixty ruta-bagas by this method in a minute, when trying hard to work against time. Of course this speed could not be kept very long. But when ruta-bagas have grown full size, say from one to two pounds apiece, and the ground is evenly stocked, an active workman can, without overexertion, pull and top in a working day of ten hours from 150 to 175 bushels. This I know to be the case, for a month ago I had the matter demonstrated in the open field, and therefore can vouch for these figures. By this method, turnips grown to full size can, without any doubt, be pulled, topped, and put in "pits" for an amount not to exceed two cents a bushel. When the ground is stony, it is well for the toppers to carry with them a piece of whet-stone, so as to keep a keen edge on their knives, which makes the work go easier, a fact soon found out in practice. (25)

IMPROVED POTATOES.

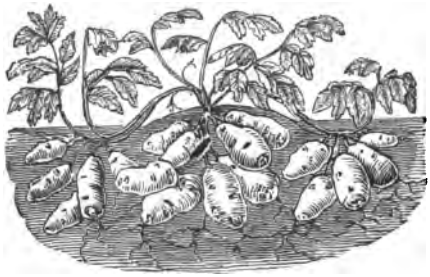
SOME time ago, the Messrs. Bliss & Sons, of New-York, the well-known seedsmen, publicly offered a series of handsome prizes to those who should bring forward the best and most prolific variety of potatoes, giving descriptions of habits, best modes of cultivation, qualities, etc. A committee was appointed to make the awards, to whom the evidence, specimens, and required details were to be submitted. Dr. F. M. Hexamer, secretary of the committee, has published the results, and the awards, which were made in 1873, and from which it appears that the variety known as Compton's Surprise proves to be the most prolific of any potato now grown. The Early Vermont ranks next.

The committee say that few new varieties have ever before been subjected to so manifold and varied a trial as these two, concerning which the following estimate is made:

COMPTON'S SURPRISE.

Compton's Surprise has received the unanimous verdict for the most prolific potato cultivated at present. Yields of from 12 to 20 pounds per hill are reported by the hun-

dreds, and in one instance 28½ pounds were dug from one hill. As a rule, the most prolific varieties are not of the best eating quality, but to this Compton's Surprise is an exception. Thousands have testified that they never ate a better potato. Its uniform mealiness of grain, combined with the purest flavor, and its snowy whiteness of flesh, which is not in the least affected by its blue skin, can not fail to make it highly valued as a family potato. This variety shows a peculiar tendency to produce a "surface crop" not found in other kinds. Its rampant growing vines lying on the ground will frequently take root, and establish a new centre of production. Subterranean branches will also likewise grow above the surface, and form self-supporting plants producing an additional crop of tubers.



COMPTON'S SURPRISE POTATO.

THE EARLY VERMONT.

The Early Vermont has more than sustained its previous reputation. Nearly all competitors declare it from one to two weeks earlier than the Early Rose, and many even more. Its uniform and large size is recognized by every one. Mr. McLeod says: "There are more than 100 in the amount I raised that would weigh from one to two pounds each," and Mr. Salter raised one tuber weighing three pounds and twelve ounces. Its superior cooking and eating qualities are unanimously commended, as well as its compact growth in the hill and its freedom from disease; and with the thousands of cultivators who have grown it alongside of the Early Rose there seems to be no doubt left that in quality, hardiness, earliness, and yield, it far surpasses that celebrated variety.

Taking the yield of Compton's Surprise as 100, the comparative yields average as follows: Compton's Surprise, 100; Early Vermont, 78; Harison, 75; Peerless, 72; Late Rose, 70; Early Rose, 62; Campbell's Late Rose, 56; King of the Earlies, 40; Early Goodrich, 35.

The committee consisted of George Thurber, F. M. Hexamer, and P. T. Quinn.

LOCALITIES.—The largest yield—609 pounds from one of seed—comes from the Far West; but in proportion to the

number of the largest products, a much smaller proportion comes from the Western States than from the East—the very wet summer there and the ravages of the Colorado beetle having, no doubt, caused this deficiency. The geographical distribution of the largest yields gives, from New-York, 24 per cent; Pennsylvania, 16; Vermont, 10; Ohio, 8; Massachusetts, 8; Minnesota, 6; Wisconsin, 5; New-Jersey, 4; New-Hampshire, 3; Indiana, 3; California, 2; and 11 per cent from as many different States and Territories.

SOIL.—The largest product, that of Mr. Salter, was grown "on a very rich sandy loam, rich in decayed vegetable matter to the depth of between two and three feet, and lying upon a compact formation known as hardpan, which has never been underdrained." Mr. A. Robinson's soil likewise was "a sandy loam, clay subsoil, where he broke up and raised potatoes last year." Mr. F. A. Smith planted his potatoes "in gravel soil with yellow clay subsoil." Most crops, however, were raised on deep alluvial lands underlaid with gravel; others on light loam with clay or gravelly subsoil, and in a few cases on heavy clay, highly manured. In but very few instances was the land artificially under-drained, which seems to be a noteworthy fact, as most writers consider drained soil indispensable for the production of good crops.

MANURES.—Of fertilizers and mixtures an almost endless variety was used, but the one substance almost invariably applied was wood-ashes. There seems to be no doubt left that ashes are the special manure for potatoes, and that even very large quantities of them occasioned no injurious effects. In a few cases, as much as one pint of ashes was applied to each hill as top-dressing, and in one instance the sets were actually planted on and covered with ashes. Plaster, lime, and salt were also extensively employed, and with great advantage. Strong nitrogenous manures have generally been considered as detrimental to the potato, but here we find that many successful growers have used large quantities of blood, fish, and Peruvian guano, and hen manure, also barn-yard manure, at the rate of fifty loads per acre, to the greatest advantage and without producing diseased potatoes. Whether older and less vigorous varieties would have withstood disease equally well under such a treatment seems, however, somewhat doubtful.

PLANTING.—The time of planting was in nearly all cases during the month of May, and more than one half of the competitors seem to have considered the 15th of May as the lucky date. In no case were larger sets than of one

eye used, and in a majority of instances these were again divided into smaller pieces, so as to give from 50 to 100 sets from one pound of seed. There appeared to be no difference in the yield between hills with whole eyes and sections of eyes. The hills were invariably placed a considerable distance apart, rarely less than three feet each way, and oftener further. As a rule, but one set was planted in a hill, and covered about four inches deep.

CULTIVATION.—It will be hardly necessary to state that in many cases the cultivation and care these growing potatoes received was unremitting and indefatigable. In no case were weeds to be seen in the patch; some of the plantations received semi-weekly hoeings, and all were kept scrupulously clean and the soil loose and mellow, yet many large crops were grown with but ordinary care. Mr. J. I. Salter swears "that the cultivation, manuring, etc., were the same he has given to his general crop of potatoes for the last five years, and in no respect had there been extra care and labor bestowed." Mr. H. C. Pearson certifies "that these potatoes were grown with the most ordinary farm culture, being hoed only twice, and receiving no extra treatment in any respect." Nearly all growers adopted the hilling system, and in only two cases were large crops obtained by level culture.

YIELD.—Although the Early Vermont gave the largest crop from one pound of seed, the average productiveness of Compton's Surprise is shown to have been greater than that of the Early Vermont. In explanation of this, Mr. Salter says: "The Compton's Surprise will, and did with me, with the same culture and soil, yield from one third to double the amount of the Early Vermont.

The committee made the following awards:

FOR THE LARGEST QUANTITY OF EXTRA EARLY VERMONT FROM ONE POUND OF SEED.

First prize to J. I. Salter, St. Cloud, Minn., 607 pounds, $100.

Second prize to H. C. Pearson, Pitcairn, N. Y., 437 pounds, $75.

Third prize to J. L. Perkins, Little Sioux, Iowa, 393 pounds, $50.

Fourth prize to Thomas J. McLeod, Black Brook, N. Y., 380 pounds, $25.

FOR THE LARGEST QUANTITY OF COMPTON'S SURPRISE FROM ONE POUND OF SEED.

First prize to Abednego Robinson, South-Newmarket, N. H., 511 pounds, $100.

Second prize to H. C. Pearson, Pitcairn, N. Y., 450 pounds, $75.

Third prize to J. I. Salter, St. Cloud, Minn., 394 pounds, $50.

Fourth prize to Frank A. Smith, Stone Church, Pa., 386 pounds, $25.

To ascertain the reliability of the statements, certificates and affidavits of the successful competitors, special pains were taken. Most of the reports were accompanied by the official indorsements of the weighers of the respective towns, and where there appeared to be any doubt, references from persons of undisputed reputation were sought and obtained. "Nevertheless," say the committee, "these products from one single pound of seed seem so miraculous that we think it not out of place to give the names and addresses of a few other producers of large crops, who, living in various States, can supply, to persons in their neighborhood, sufficient proofs of the correctness of their representations. The subjoined are selected for this purpose:

By whom grown.	Pounds Compton's Surprise.
J. H. Dormann, Batavia, N. Y.	500
Elijah Wood, Concord, Mass.	416
Frederick Seiler, Verona, N. J.	384
A. W. Titus, Wilmington, Vt.	370
David R. Wood, Morrisville, Vt.	369
E. S. Brownell, Essex, Vt.	368
J. R. Aten, Upper Mt. Bethel, Pa.	350
H. P. Sharpless, Fairville, Pa.	338
Eugene E. Graves, Black River, N. Y.	325
Leonard Wood, Morrisville, Vt.	320
H. S. Goodale, South-Egremont, Mass.	319

By whom grown.	Pounds Ex. Early Vermont.
Robert Sutor, Brady, Pa.	336
E. S. Brownell, Essex, Vt.	335
Samuel Neal, Wyocena, Wis.	320
Charles Whiting, Jasper, N. Y.	307
J. D. Van Doren, Hicks' Corner, Wis.	296
D. Steck, Hughesville, Pa.	264
Thomas Cowing, Alexandria, Minn.	254
A. W. Titus, Wilmington, Vt.	251
H. Hamilton, Seneca Castle, N. Y.	250

POTATO BLIGHT AND ROT.

DR. THOMAS TAYLOR, of Washington, D. C., communicates to *The Lens* the result of experiments upon potatoes, for the examination into the chemical and structural theories of Dr. Lyon Playfair and the fungoid views of several leading mycologists. Among other tubers, one half of a potato brought from Santa Fé, New-Mexico, was placed in water with a diseased specimen, and the other half in water to which sugar had been added. An Ohio potato was similarly arranged, and the effect of allowing it thus

to remain for a considerable period noted. On the twentieth day, the Ohio specimen had entirely dissolved, while the Santa Fé potato was uninjured. Comparing the portions in the sugared water, the Ohio tuber appeared a mass of infusorial life, mycelium, and budding spores, with a strong odor, no starch cells being discernible.

The New-Mexican specimen showed few infusoria, and the starch granules arranged in cellulose, between which bundles of mycelium and budding spores appeared in profusion. No liberated granules were visible. Since these experiments, other northern and eastern varieties have been tested by fungoid solutions in contrast with some of the New-Mexican varieties, giving like results, clearly demonstrating the superiority of the Santa Fé potatoes over all others thus far examined, in respect to their powers of resisting fungoid and infusorial action.

We note that the government is about to test, by samples of every variety of potato from the above-mentioned locality, their anti-fungoid qualities in the open field and in contrast with the usual varieties grown in that section of the country.

COMPONENTS OF THE POTATO.

IN 100 parts of Irish potato, there are: Water, 70.00; starch, 24.00; azotic matter, 1.60; fatty matter, .10; sugar, 1.09; skin, 1.65; mineral matter, (salts,) 1.56; total, 100.00. The potato produces at least 30 per 100 of dry matter, 1.65 of which must be subtracted for the skin, which reduces the food part to 28 per 100, 24 parts of which are starch.

REMEDY FOR THE COTTON-WORM.

THE cotton-plant worm, according to Prof. Riley, destroyed in the Southern States 20,000,000 dollars' worth of cotton in one fortnight during the summer of 1872. In 1788, according to the same authority, this worm destroyed 200 tons of cotton in the Bahamas. In 1793, it completely destroyed the entire cotton crop of Georgia. Its ravages were observable again in 1800; and in 1804, 1825, and 1826 it was very destructive. Since the last date, it has done more or less damage to the crops almost every year, in some part or other of the cotton-growing district. Like the army-worm of the Middle States, it swarms in particular years to such an extent as to utterly ruin the crop, while in other years it is scarcely noticed. There is no ground, however, for supposing that its appearance is periodic.

Prof. Riley asserts that this insect pest may be easily destroyed by the employment of Paris green. He recommends mixing the Paris green (arsenite of copper) with

thirty parts of flour, plaster, slacked lime, or ashes, and dusting the plants lightly with the mixture. The green costs not over twenty-five cents per pound, and thus the cotton-worm might be destroyed over a large field at an inconsiderable expense. Prof. Riley suggests the following method of procedure: "The mixture is put in a tin box attached to the end of a stick three or four feet long. The least possible dusting suffices; and, by taking the handle of the dust-box in the left hand, and then tapping the box with another stick held in the right hand, one can walk rapidly along the rows and regulate the amount deposited. It is best to dust the plants early in the morning while they are moist with dew."

A NEW BEECH-BLIGHT.

By J. König.—In Westphalia the beech-trees have been recently attacked by a new form of blight, which, commencing on the bark, finally covers the tree with a snow-white down, producing sickness, and sometimes death. The microscope shows this blight to consist of fine threads, among which occurs a small insect, apparently an undescribed species. These threads, which are secreted by the insect, consist of wax, which has a melting-point of 78°–80°, and the percentage composition of which is carbon 81.39, hydrogen 13.58, oxygen 5.03. Both composition and melting-point are very near to those of Chinese wax. The wax was in part saponified by potash. The soap shaken with ether yielded a substance melting at 49° –51.5°, solidifying at 50°–48° and containing carbon 76.21, hydrogen 12.24, oxygen 11.55. From the soap an acid was obtained, melting at 51.53°, and solidifying at 50°–49°, the composition of which was, carbon 77.88, hydrogen 12.31, oxygen 9.81. The unsaponified portion melted at 140° –145°, and must clearly have been rich in carbon. Want of material prevented further investigation. (32)

DEATH TO CHEESE-WORMS.

It is stated by Caleb Green, of Osseo, Mich., that by placing a cheese containing these insects on a grating in a vessel, and then exhausting the air from said vessel for twenty-four hours, the skippers will drop down and the cheese may be taken out free from them.

TO PROTECT WOOD FROM MOISTURE.

The wood is coated several times with hot linseed-oil varnish; and, after drying, is painted with oil-colors. Thus treated, it is extremely weather-proof, and is rendered much more durable than by simply coating with paint. The drying, however, requires a longer time.—*Dingl. Polyt. J.*, ccvii. 515.

A HOME-MADE FERTILIZER.

FARMERS generally have to pay a high price for an article which with a little skill they could make themselves during the winter months or on rainy days, when they have little else to do. We give a recipe for a cheap, good fertilizer, which has been used successfully by farmers in Pennsylvania and Ohio. One recommends it especially for potatoes and wheat, and ends by saying that he has used it with success on corn and other products. It is as follows: Take 1000 lbs. of good mold, sieve and screen it to get the gravel out and make it as fine as possible, then spread on a floor or some suitable place; add 100 lbs. sulphate of ammonia, 100 lbs. common salt, then mix with a rake. When thoroughly mixed, add 25 lbs. pearlash and 25 lbs. sulphate of soda, mix well, then add 400 lbs. ground bone, 25 lbs. best Peruvian guano, and 150 pounds ground plaster. Mix the whole thoroughly, throw on a pile for forty-eight hours, and it is fit for use. If it is to be used for potatoes in districts where potato-bugs are numerous, 5 gallons sulphuric acid may be sprinkled over the mass. Care must be taken not to use the acid in a confined place, as the fumes are bad for the health. If it is spilled on the floor, do not throw water on it, as it generates great heat when in contact with water. Sulphuric acid sprinkled on the ground will kill bugs of any kind, and its fumes are especially fatal to the potato-bug.

FERTILIZERS.

IN many parts of Texas, South-America, Australia, and other places, cattle are slaughtered in large numbers merely for their hides and tallow—the latter being separated by boiling the carcases, and the residue left after the tallow is extracted has heretofore been wasted, but Hannell Stevens, of Brazoria, Texas, proposes to utilize this by separating the liquid matter, evaporating it to a sirup, and then mixing such sirup with the solid animal matter and plaster-of-Paris, thus forming a fertilizer of good quality, which may be packed in barrels or bags for transportation, or may be readily shipped in bulk to distant places.

HOME-MADE MANURES.

MR. M. W. TERRILL, of Middlefield, Ct., says that constant deterioration of the soil follows cropping with insufficient manuring. Eternal vigilance is the price of safety from this loss of fertility. The first source of supply is the barnyard and barn-cellar, the droppings of animals, supplemented by muck, sods, road scrapings, litter, all decaying matter of the farm, house-slops, bones, etc., many

articles being simply added as absorbents; and if the bulk of the stable-manure be thus doubled, the value will be more than doubled at the same time. The second and cheapest source of supply of fertility is turning under green crops. This is especially applicable on all light, dry lands. Two crops of buckwheat may be turned under the same year, one of rye and one of buckwheat; or one crop of grain and one green manure crop may be secured the same season. Where the land is good enough for clover, red clover is the best manure crop. The peculiar beneficial action of certain saline and alkaline manures was described, particular reference being made to that of plaster, salt, and ashes; marine manures and nitrogenous commercial fertilizers and phosphates being useful to supplement the two great sources of supply of plant-food, the barnyard and green manure crops. His conclusion is, that practically we may constantly improve the soils of our farms while we are taking off constantly increasing crops year by year.

INFLUENCE OF MANURES ON WEEDS.

By R. Heinrich.—The author, in some manuring experiments on red clover, found the following percentages of weeds in the crops: Without manure, 57 per cent; with ammonium sulphate, 30; sodium nitrate, 26; sulphuric acid, 18; magnesium sulphate, 10; sodium chloride, 7; potassium sulphate, 5.5; calcium carbonate, 4.9; quicklime, 4.5; superphosphate, 4.4; and with gypsum, 1.9 per cent.

It would thus seem that lime-manures, and especially gypsum, exert a special action in helping the clover in its struggle for existence with other plants, besides increasing the yield; while nitrogenous manures are not so specifically favorable to clover, but almost equally so to the other plants. Observations on the effect of different manures on the weeds, in connection with other crops, would be of great practical interest. (32–36)

ATMOSPHERIC NITROGEN IN VEGETATION.

By P. Dehérain.—It has been shown experimentally that the quantity of nitrogen contained in a series of vegtable crops is greater than that contained in the manure employed for their cultivation, also that in a soil so manured the quantity of nitrogen increases. Moreover, the high lands, which are not manured, do not become sterile, although they must be deprived of a considerable quantity of nitrogenous matter by the cattle which pasture there in the summer. Again, the soil of forests is constantly deprived of nitrogenous matter by the growth and removal

of trees without becoming sterile; from these facts, it follows that the soil gains nitrogen from the atmosphere. The author first supposes that the nitrogen is converted into nitric acid by the eremacausis of vegetable matter. To confirm this hypothesis, he heats glucose and ammonia, glucose and potash, and ulmic matter in sealed tubes, together with a measured volume of air. A quantity of nitrogen is found to be taken up by these means, but evidently not to form nitric acid, for the quantity of nitrogen which disappears would require—to form nitric acid—considerably more oxygen than was contained in the tubes. Moreover, carbonic acid is formed in considerable quantity; no cyanogen is formed. He concludes that the nitrogen unites with hydrogen to form ammonia. The experiments were repeated at ordinary temperatures, employing decayed wood sawdust and glucose mixed with alkali, and allowing the process to continue for a week or a fortnight, and in nearly every case a considerable quantity of nitrogen was absorbed. Under the supposition that the presence of oxygen—by combining with hydrogen—checks the formation of ammonia, he passed a current of pure nitrogen into heated mixtures of alkali and glucose, and found that 6.5–7.1 gr. of nitrogen was absorbed by 1 kilogr. of glucose, only 1.5 gr. of nitrogen being absorbed by the same quantity when air was passed instead. The substances when heated after the reaction emitted a strong odor of burnt horn, indicating the presence of ammoniacal compounds. In 21 experiments, at the ordinary temperature, out of about 90 c.c. of pure nitrogen 0.5–5.9 c.c. were absorbed, excepting in two cases, which gave negative results. He considers that these experiments prove —1. That atmospheric nitrogen can, either in the cold or at the temperature of the soil, fix itself on carbonaceous matter analogous to that which is formed in vegetable decomposition; 2. That the presence of oxygen is unfavorable to this reaction.

Carbonaceous material in manure is advantageous, since —1. It liberates hydrogen in decomposing; 2. It renders the conditions for absorption of nitrogen more favorable by removing oxygen from the air confined in the soil.

(32)

INFLUENCE OF THE SMOKE FROM THE FREIBERG WORKS.

By Dr. Frectag.—1. Sulphurous, sulphuric, and arsenic acids and zinc salts contained in the smoke and fumes condense with the dew on the leaves, or come in contact with the bedewed leaves, and on evaporation of the mois-

ture a more concentrated corrosive residue is left, which quickly decomposes and kills these leaves, and so vegetation is rapidly extinguished. Chemical analysis and observations of the appearance of the vegetation readily detect the presence and effect of these deleterious substances. Poisoning of the soil or of the entire plant is out of the question.

The metallic oxides and salts adhering to the leaves of the fodder may be dangerous to animal organisms, in causing inflammations and corrosion of the mucous membrane of the digestive organs, and under very unfavorable circumstances even death itself. This fact may always be established by dissection and chemical analysis. (36)

CAOUTCHOUC FROM COMMON PLANTS.

THE extensive demands for india-rubber, and the comparative scarcity of the supply, has augmented the price until it now stands at nearly one dollar per pound in this market. The crude matter comes from tropical regions, and is derived mostly from certain trees, the nomenclature and localities whereof were presented in a recent article in the *Scientific American*.

A variety of attempts to find substitutes for rubber, or new sources of supply, have been made. In the matter of substitutes, several valuable compositions have been invented, which are used in place of rubber for specific purposes.

Among the new sources of supply are the fruits, seeds, and juices of various plants, which have been successfully treated by Mr. D. M. Lamb, of Strathroy, Canada. By fermenting the asclepia or common milkweed plant, followed by pressure and evaporation, he separates a gummy liquid, having the characteristics of rubber, and, like it, capable of vulcanization.

From the bamboo-berry grown in the South, from flaxseed and other seeds, he also obtains in this manner a similar gum, from which, it is said, a good article of vulcanized rubber may be made, and also an excellent waterproof varnish. It is alleged that these substances may be produced at a cost not exceeding 20 cents per pound, and that a company with a large capital subscribed is about to produce the manufacture here.

COMBINED SPADE AND FORK.

HEBER STONE, of Galveston, Tex., proposes to furnish a fork with a cover in the form of a shovel into which the fork may be placed as in a sheath when it is desired to use the implement as a spade.

ON SOME PROPERTIES OF GYPSUM.

By A. Cossa.—The power of gypsum to augment the fertility of soils may doubtless be ascribed in great measure to its property of facilitating the decomposition of complex rocks containing alkaline silicates, and thereby bringing the alkalies into a condition favorable to their ready absorption by the roots of plants.

To estimate the intensity of this decomposing action, the author has compared the quantity of matter dissolved, in a given time and within given ranges of temperature, from various rocks by a saturated solution of gypsum, with the quantities dissolved out of the same rocks under similar conditions by pure distilled water. He finds that 1000 parts of pure water dissolve 2.19 parts of pure crystallized gypsum at 16.25° and 2.352 at 22°, numbers agreeing nearly with those obtained by other experimenters.

The rocks were reduced to very fine powder and left for twenty days in contact with a saturated solution of gypsum at temperatures ranging from 16° to 22°. The results are given in the following table, together with those obtained in like manner with pure water:

	Matter dissolved out.	
	By pure water.	By a saturated solution of gypsum.
	Per cent.	Per cent.
Gneiss, containing undecomposed orthoclase and potash-mica	0.1250	0.4630
Trachyte, decomposing, from Monte Chioja, Vicenza	0.0937	0 2562
Trachyte, undecomposed, from Monte Ortona, (Euganian Hills)	0.0871	0.1380
Trachyte, porphyroidal, decomposing, (containing sanidine, mica, hornblende,) from San Pietro Montagnone, (Euganian Hills)	0.0567	0.0927
Trachyte from San Daniele	0.0750	0.1630
Granite, (albite, quartz, mica,) from Montorfano, Lago Maggiore	0.0727	0.2070
Granite, (orthoclase, mica containing a trace of lithia, quartz,) from Baveno, Lago Maggiore	0.0996	0.2875
Felspar, white, compact, in veins in Diorite, from Mosso, Biella	0.3500	0.7140
Basalt, compact, of Monte Nuovo, (Euganian Hills)	0.1271	0.3040
Perlite, from Monte Sieva, (Euganian Hills)	0.0624	0.1982

The solvent action exercised by gypsum on rocks containing alkaline silicates may perhaps give rise to the presence of potash, soda, and lithia in certain mineral waters, especially in sulphureted waters.—*Gazzetta Chimica Italiana.*

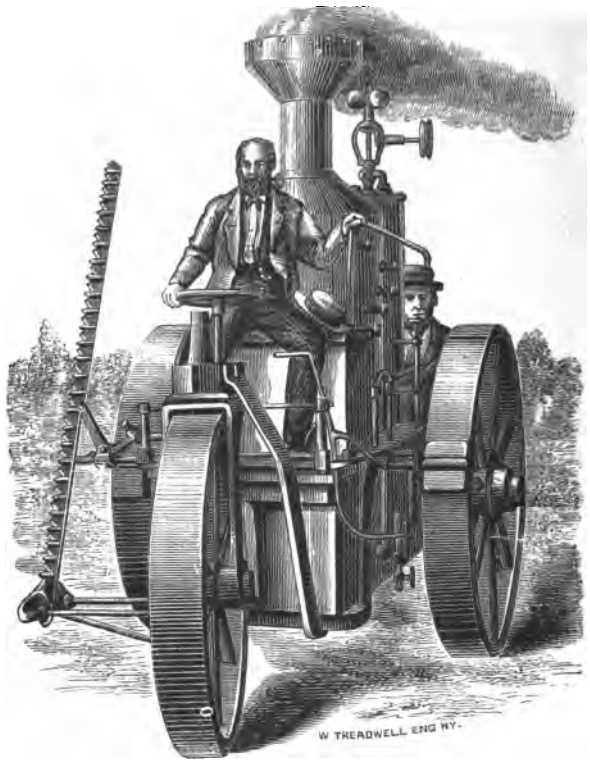
A MAMMOTH CHEESE.

THE Painesville (O.) *Telegraph* describes a mammoth cheese which lately passed through that town on its way east. It was mounted on a substantial platform, to which were attached small cast-iron wheels, so that it easily moved; and the platform, in turn, was mounted on a heavy lumber-wagon, drawn by two span of horses. The cheese was cased in a tight-fitting cheese-box, which was firmly secured to the platform to prevent sliding. Its measurement is: Height, 3 feet 2 inches; diameter, 5 feet 4 inches, and circumference, 16 feet. Its net weight is 4050 pounds. In quality it is said to be fully equal to any of the Carter cheese, which stands so prominent in every market. It was manufactured for Messrs. Gass, Doe & Chapin, of Boston.

CHINESE METHOD OF CATCHING DUCKS.—The Chinese have queer ways of catching water-fowl. Sometimes they spread great vertical nets with large meshes near the surface of the water, so that the wings of the birds become entangled therein just before they alight. Another arrangement is a sort of net-trap held open by the bamboo sticks, which, when the birds perch upon them, fall and allow the game to become entangled in the meshes. Perhaps the most ingenious idea is carried out by men who enter the water entirely nude, wading in up to their necks. Over the head is placed a sort of helmet, which is pierced with holes for sight, breathing, etc.; and resting on the man's shoulders is a wooden shelf, on which, just in front of the sight-orifices of the helmet, is placed a number of cups containing corn or seed. The bird, attracted by the bait, alights upon the shelf, when the fowler grabs his prey by the legs with his hand, draws it under the surface, and secures it in a net bag which is worn about his waist.

POTASH IN DIFFERENT KINDS OF ASHES.—A correspondent of *The Country Gentleman* gives the following table, showing the amount of potash contained in 1000 pounds of ashes, made from burning different kinds of woods: pine, ½ pound; poplar, ¾ pound; beech, 1½ pounds; maple, 4 pounds; wheat-straw, 4 pounds; corn-stalks, 17 pounds; oak-leaves, 24 pounds; stems of potatoes, 55 pounds; wormwood, 73 pounds; sunflower-stalks, 19 pounds; oak, 2½ pounds; beech-bark, 6 pounds. The remaining portion of the ash, consisting of carbonate and phosphate of lime, iron, manganese, alumina, and silica, is an excellent fertilizer.

STEAM MOWING, REAPING, AND THRASHING.



STEAM MOWING, REAPING, AND THRASHING MACHINE.

MR. MARCELLUS V. CUMMINGS, of Geneseo, Henry County, Illinois, has brought into successful use in that State a new invention for the purpose above mentioned, which is illustrated in our engraving, which is from a photograph of the machine. The boiler is thirty-one inches in diameter by five feet in length, and is of the tubular pattern. There are two steam-cylinders, each four by eight inches, together with a water-tank holding five barrels of water, and coal-bunkers containing five bushels of coal. The large driving-wheels are five feet in diameter and eight inches in tread; the front steering-wheel, operated as shown, is four feet in diameter, with similar tread. The

grass-sickle cuts six feet four inches, and the grain-sickle nine feet six inches.

The inventor states that he drives his engine from farm to farm without the aid of horses, and that it traverses over plowed land, up-hill or down, with the greatest ease. The rate of speed is about four miles per hour, and an acre of ground can be mown in twenty minutes. The grain-thrashing machine is placed on a two-wheeled carriage, which is coupled on behind the engine, and is thus hauled by the latter over country roads, from place to place throughout whole counties. The entire weight of the apparatus is 4200 pounds. (83)

ARTIFICIAL OSTRICH-HATCHING.

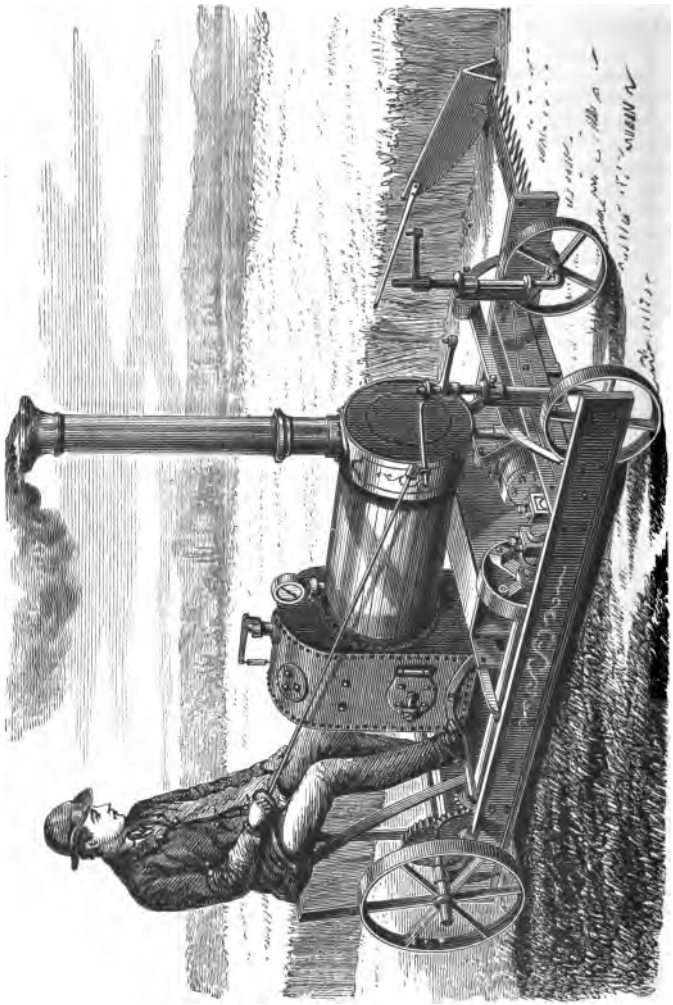
We learn from the *Grahamstown* (Cape Colony) *Journal* that ostrich-hatching by artificial means is succesfully carried on at Hilton, in that colony. The editor says: "We saw the incubator, and in it forty-five eggs, in the process of hatching. This operation is now performed to almost perfection, quite equal to any thing the parent birds can do themselves, even supposing they are unmolested and escape all kind of accidents to which they are exposed. Out of the forty-five eggs we saw, we may safely conclude forty-two would produce live and healthy chicks. The results now, of several batches, are fourteen out of fifteen to be hatched; and Mr. Douglass seems pretty sanguine that he shall presently hatch all the eggs placed in the incubator." There are one hundred and fifty-five ostriches at Hilton, of which seventy-five are this year's chickens.

CULTIVATION OF SUGAR-CANE.

It is stated by Wm. Green, of New-Orleans, that if shortly after the removal of the cane, the stubble is cut smoothly near the surface of the ground and covered with three or four inches of soil, the vitality of the plant is preserved for the succeeding crop, instead of perishing from exposure to the weather, and the expense and loss from replanting avoided.

PIPE FERTILIZATION.

As an improvement in the prevailing style of agriculture, W. H. Pugh, of Chicago, proposes to lay down pipes, porous or perforated on their upper sides, but impervious below, at a suitable distance below the surface, through which water, (either hot or cold,) liquid manure, hot air, or steam may be supplied in such quantities and times as may be deemed desirable, so that the tiller of the soil may either dry, moisten, or warm it to suit his own pleasure.



NEW STEAM REAPER AND MOWER.

NEW STEAM REAPER AND MOWER.

OUR engraving shows a new steam reaper and mower, recently patented by Mr. Edward Hayes, of London, England.

The implement consists of a boiler and steam-engine, erected on a light wrought-iron girder-frame, the whole being carried on four wheels, of which the two hind wheels are utilized for propulsion and the two fore-wheels for steerage and for carrying the cutting apparatus from off the ground. The boiler and engine are specially designed to develop a maximum of power with a minimum of weight; and the steam is used at a pressure of 120 lbs. to the square inch in the boiler. The piston speed is high, and is applied by suitable intervening mechanism to the double motions of actuating the cutter-bar and propelling the implements by means of the driving wheels. With the object of not overloading the frame and machine, the storage-room for fuel and water is very limited, and arrangements must be made for supplying the tender with these requisites at suitable localities. The machine is worked by two hands, a man to steer and a boy to attend the fire.

This entirely novel invention is self-propelling, and altogether its weight does not exceed that of the combined reaper and mower in every-day use. It will be recognized by practical men as a great gain, inasmuch as the horses are exposed to injury and laming in drawing ordinary machines, and this class of work is undoubtedly the most trying to them in the hot weather of harvest-time. The farmer will, by the use of this apparatus, not only be enabled to reserve his horses for more advantageous labor, but he will have the means of acting promptly and expeditiously when occasion serves and requires, without reference to the antagonistic influences of weather or man, so far as it is humanly possible. (106)

REARING SILKWORMS IN THE OPEN AIR.

A SWISS sericulturist, M. Roland, of Orbe, Canton de Vaud, proposes stamping out the diseases incident to the silkworm, by rearing them in the open air. He is of opinion that all their diseases are produced by the present ill-judged mode of breeding in "magnaneries," which are kept at a high temperature, with all access of fresh air shut off.

The author's plan for raising the worm on the tree is briefly as follows: The tree must not exceed two and a half feet in height, and must be kept trimmed. He surrounds it with a cylinder of wire-gauze, with top and

floor of canvas, to exclude noxious insects. This cylinder he calls a *manchon*, (muff.) The worms are placed on the top of the tree. When the leaves are nearly all consumed, the animals are removed to another tree, protected, of course, with the manchon as before. If the ova are to be hatched in the open air, the worms are left on the tree after the fifth moult; but if not, then they are taken into the magnanerie. By this means, good, healthy grain is sure to be obtained, and after three years of life upon the tree, the blood of the larvæ is found under microscopic examination to be exactly like that of the wild bombyx.

It is not claimed that open-air rearing is favorable to the abundant growth of silk, but only that it improves the eggs and gives vigor to the breed.

MOSS GATHERING.

AMONG the articles of commerce furnished by nature in this semi-tropical climate of ours, says the New-Orleans *Times*, is moss. This long, luxuriant parasite clothes and festoons the trees with its dull drapery all over the woods and swamps of Lower Louisiana. The same humidity and warmth in the atmosphere which deprive man of the will to work, foster and nourish the growth of this strange plant, and thus afford him, if he would avail himself of the opportunities, an easy way of making a living. The supply of moss in our forests is simply inexhaustible. There are trees loaded down with it standing on thousands of square miles in this State, and even when the tree is denuded of its weird-like garb, in less than a year it comes out in a dress as ample as that of which it had been stripped The waters of all our swamps are filled with it, where it has dropped from the trees, and lies rotting, ungathered, and uncared for. The whole country where this moss grows is accessible to any one desirous of turning it to account. Bayous and streams navigable for large boats intersect the woods and swamps where it grows, in every direction. But, strange to say, this moss interest, which might be made so great here, is neglected, although it presents so many inducements to those who are desirous of gaining an honest livelihood.

Most of them, with that prodigality and wastefulness which are part of the nature of our people, cut the trees down to gather the moss on them, and thus kill the goose which lays the golden eggs, without even eating the goose, for they leave the tree to rot where it lies, after stripping it of its sombre covering. But some of them are more economical, and, having an eye to future wants, more properly climb the trees among the moss, which they gather off

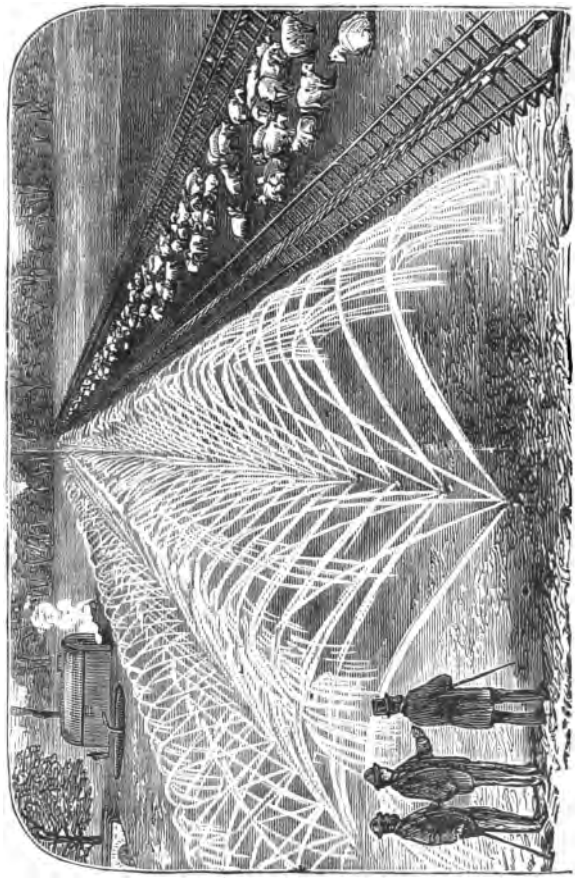
the limbs and throw to the ground in a pile. These heaps are left standing for some time, and the rain, with the dews, thoroughly saturating them, they undergo a species of "sweating," like tobacco, which rots off the gray covering and leaves the black, fibrous horsehair-like material, which is the moss of commerce. This is usually transported to market in flats and boats of the swamps. It is packed up near the place of curing in rude bales with rope ties. When it arrives in New-Orleans, it passes under the manipulation of moss-pickeries and through the machinery of gins, after which it is pressed into bales under steam pressure, bound with neat iron ties, and is then ready for shipment. The men who gather this moss usually live on the banks and islands of the bayous which lead through the swamps. Most of those at present engaged in it are Germans and Creoles, who live very comfortably on the spots of high land which are found almost everywhere in the swamp country of Louisiana. They prepare their moss in rather a rough manner to be sold advantageously in the New-Orleans market, but there the "country moss" is nearly always rehandled and refined, as it were, by the exporters of Louisiana moss. After the necessary preparation is made with the rough material, these parties find no difficulty in selling their moss in the northern markets.

A NEW WAY TO MAKE CHEESE.

ACCORDING to a statement of Henry O. Freeman, of Sherburne, N. Y., cheese of "excellent quality" may be made by melting fifteen pounds of fat, such as tallow, lard, or cheap butter, and mixing it with one thousand pounds of skim milk heated to about 100° F., so as to form an emulsion, which is constantly stirred until the heat is reduced to about 84°, when the rennet is added and cheese made as in the usual process. Three onnces of saltpetre may be added to the milk if preferred.

WEEDS AS INDICATORS OF SOIL.

PROFESSOR VOLSKE, says *Les Mondes*, has found by analysis that, of the *carduus acaulis* and *utricar repens*, two useless weeds which infest fields in France, the first grows principally in soils rich in potash, and the other in soils largely containing silica as well as phosphate and sulphate of lime. It would be a good idea for agricultural chemists to avail themselves of the hint, and, by determining the nature of the ground in which our most common weeds are principally found, thus afford to farmers a ready way of approximately determining the quality of their land.



NEW METHOD OF PASTURE IRRIGATION.

NEW METHOD OF PASTURE IRRIGATION.

As shown in our illustration, this method involves a series of artificial showers through pipes fed from a large reservoir, through the means of a steam-engine that pumps the water into them, and forces it out in jets, or a sort of artificial rain. This mode of irrigation, which is usually brought into requisition at night, is found to be most beneficial, and tends greatly to the growth of grass and the

fructifying of the soil. Our engraving shows the apparatus as used in England, and the arrangements for pasturing sheep in connection with it. Plot after plot is taken in rotation, until the whole space covered with pipes has been gone over.

ON THE BURSTING OF TREES AND OBJECTS STRUCK BY LIGHTNING.

By Professor Osborne Reynolds, M.A.—The results of the experiments referred to in this paper were exhibited at a recent meeting of the Manchester Philosophical Society. The suggestion thrown out by Mr. Baxendell —that the explosive effect of lightning is due to the conversion of moisture into steam—seemed to me to be so very probable that I was induced to try if I could not produce a similar effect experimentally.

1. I first of all tried to burst a thin slip of wood by discharging a jar through it, taking care so to arrange the wood that the discharge should be of the nature of a spark, and not a continuous discharge. This was done by making the wood to form part of a discharging rod, with balls on the ends.

This experiment was successful in the first attempt, although the results were on a small scale. It should be mentioned that the wood had been damped with water. This experiment was repeated with larger pieces of wood with various results.

2. It then occurred to me to try with a glass tube. This I did at first with a very small tube, passing wires from the ends of the tube until they were within $\frac{1}{2}$ inch of each other.

The small tubes burst both with and without water.

3. I then used a larger tube, (about $\frac{1}{10}$ inch bore,) using it in a similar manner. The discharge without water produced no effect on this, even when repeated several times, but when the tube is full of water (with the ends open) the first discharge shattered that part of the tube opposite the gap in the wire. This tube was bent in the form of a siphon, and the water stood about 1 inch beyond the gap in the wire on each side of it.

4. I then tried a stronger tube which I had been using for insulation. It had a bore of $\frac{1}{8}$ inch, and was $\frac{3}{8}$ inch in external diameter. It was capable of sustaining a pressure of probably 10,000, and certainly 5000 lbs. on the square inch; that is to say, a pressure of from two to five tons per square inch. It was about 14 inches long, and bent in the form of a square-ended siphon. The gap in the wire was about $\frac{1}{2}$ inch, and the water extended about $1\frac{1}{2}$ inches

on each side of the gap. The ends of the pipe were open, and the jar charged in the same manner as before, with about 100 turns of a 12-inch plate-machine. The surface of the jar is about half a square foot, and the discharge, when effected with the common rod, took place through about 2 inches of air.

This tube was shivered at the first discharge. That part opposite the gap and for some way beyond is completely broken up into fragments which present more the appearance of having been crushed by a hammer than of being the fragments of a pipe burst under pressure. Some of the fragments show that the interior of the pipe has been reduced to powder.

These fragments were scattered to some feet on all sides, but there was nothing like an explosion. I held the pipe in my hand at the time of the discharges, and the sensation was that of a dead blow. There was no noise beyond the ordinary crack of the discharge.

The manner in which this pipe was destroyed clearly showed that a larger one might have been broken. But as it was two o'clock, and my fire was out, I did not continue the experiments.

It is not easy to conceive the precise way in which a pressure of probably more than 1000 atmospheres could be produced and transmitted in a pipe of water the ends of which were open. It might have been caused by the sudden formation of a very minute quantity of steam, or by the expansion of the water; but whichever way it was, its effect was due to its instantaneous character, otherwise there would have been an explosion.

When we consider the great strength of this pipe, (which might have been used for a gun without bursting,) and when we see that it was not only burst, but that the interior of the glass was actually crushed by the pressure, and all this by the discharge of one small jar, we must cease to wonder at the bursting power of a discharge from the clouds.

DESTROYING TREE-BUTTS.—A New South Wales paper recommends the following method of getting rid of the stumps and roots of timber in cases where grubbing up is not considered desirable: In the autumn bore a hole 1 or 1¼ inch in diameter, according to the girth of the stump, vertically in the centre of the latter, and 18 inches deep. Put in 1 oz. or 1½ oz. of saltpetre; fill the hole with water, and plug up close. In the ensuing spring, take out the plug, and pour in half a gill of kerosene-oil, and ignite it. The stump will smoulder away, without blazing, to the very extremities of the roots, leaving nothing but ashes.

DOMESTIC ECONOMY.

ON THE POWER WHICH CERTAIN SUBSTANCES POSSESS OF PREVENTING PUTREFACTION AND THE DEVELOPMENT OF PROTOPLASMIC LIFE AND OF FUNGI.

By F. Crace Calvert.—In experiments made upon a solution of albumen to which was added one thousandth part of each of the substances whose antiseptic properties were to be studied, results were obtained which may be divided into four classes:

1. Those substances which entirely prevent the development of protoplasmic life and of fungi: these are phenol and cresol.

2. Those which prevent the development of vibrios without stopping the production of fungi: zinc chloride, mercuric chloride, and zinc sulphophenate.

3. Those, on the contrary, which permit the production of vibrios, and prevent fungi: lime, quinine sulphate, pepper, and prussic acid.

4. Those which prevent neither the production of protoplasmic life nor of fungi: sulphurous, sulphuric, nitric, arsenious, and acetic acids; caustic potash, soda, and ammonia; solution of chlorine; sodium, calcium, and aluminium chlorides; calcium hypochlorite; potassium chlorate; calcium sulphate; ferrous sulphate; calcium bisulphate; sodium thiosulphate; sodium phosphate; calcium phosphate; potassium permanganate, potassium and sodium sulphophenates, picric acid; turpentine; wood charcoal.

Acids, while not preventing the development of vibrios, facilitate the production of fungi: this applies especially to sulphuric and acetic acids. Alkalies, on the contrary, are not favorable to the production of fungi, but favor the development of vibrios. Zinc chloride and mercuric chloride completely prevent the development of animalcules, but do not stop the formation of fungi. Chlorine and calcium hypochlorite only stop the production of vibrios when employed in great excess, and when calcium hypochlorite is so used, it acts with violence upon the proteic matters, producing a disengagement of nitrogen. Quinine sulphate completely stops the formation of fungi, and this fact leads to the supposition that, as quinine sulphate is remarkably efficacious in cases of intermittent fever, this malady may be caused by the introduction into the human economy of

fungoid bodies. This seems all the more probable when it is considered that this fever only exists in swampy countries where there is much decomposition of vegetable matter. Wood-charcoal possesses no antiseptic properties; it absorbs the putrid gases produced and causes their oxidation. (58)

THE SMOKOMETER.

WE have heard of the idea of laying oxygen in pipes through dwellings for purposes of ventilation and purification of the air, of the scheme for similarly supplying carbonic acid for the extinguishment of fire, and of the ingenious proposal to supply milk to our dwellings through conduits leading from suitable reservoirs. Further still, we have perused the glowing prospectus of the electric piano inventor, who proposes to give us the means of turning off or on a flow of music as easy as a stream from a water faucet, and we remember having read of the telephone by which the choicest vocal efforts of celebrated singers might be brought into our parlors as easily as the voice of the Bridget hailing us from the nether world through the speaking-trumpet. But now we have found an idea which surpasses all. According to the *Virginia City Territorial Enterprise*, a Professor Maulesel is going to erect extensive works similar to those of a gas company. In these, there will be large retorts in which tobacco will be burned, and the smoke thus produced will pass through proper pipes to a large bell-shaped receptacle, similar to a gasometer, where it will be cooled and purified and so scented as to have the flavor of the finest Havana cigar. From the smokometer a main pipe will lead up into the city, and from this will be small branch pipes leading to all the principal houses and saloons in the town. In every house where the smoke is taken, there will be placed a meter, similar to a gas-meter, but much more delicately constructed. Running from these meters will be pipes leading to all the rooms in the house, and connected with these pipes, at convenient points, will be long flexible tubes, each tipped with a handsome amber mouthpiece for the comfort and convenience of smokers.

When a man desires to take a smoke, he has not to go to the trouble of hunting up tobacco and filling his pipe, then of finding and lighting a match, and perhaps burning his fingers, and afterward getting fire and ashes upon his clothes, half a dozen times before his smoke is ended. There is none of this trouble and vexation. He has only to place the amber mouthpiece between his lips, turn a small silver thumbscrew, and the cool, delicious, perfumed smoke glides into his mouth. By this ingenious and de-

lightful arrangement, all danger of fires from pipes and cigars will be obviated, and millions in valuable property annually saved.

An india-rubber receptacle filled with smoke is arranged in the breast, inside the shirt-bosom, for smokers to draw from while walking in the street; and ladies, with whom it is conjectured the delicately flavored fumes will become very popular, are to have for their use elegantly carved amber mouth-pieces, hooped about with gold and set with diamonds and other gems. When out walking, their reservoir of smoke will be contained in the pannier, to which it will impart a much more symmetrical shape than can be attained by the use of newspapers; besides, by giving the rubber of the smoke-tank a suitable thickness and strength, it will be found to be very convenient when the wearer desires to sit, as it will serve as a cushion, a something which is often a great convenience and comfort.

(83)

ANALYSIS OF TEA.

ZÖLLER'S analysis is as follows:

Potash	39.22
Soda	0.65
Magnesia	6.47
Lime	4.24
Oxide of iron	4.38
Protoxide of manganese	1.03
Phosphoric acid	14.55
Sulphuric acid	trace
Chlorine	0.81
Silica	4.35
Carbonic acid	24.30
	100.00

PHOSPHORIC ACID IN MILK.

MEYER had remarked that in the grain of cereals the phosphoric acid and nitrogen are in the proportion of $P_2O_5 : 2N$; Stohmann finds that these substances bear the same proportion to each other in goat's milk.

VANILLA-BEANS are rubbed by the natives of South America and Mexico with cajou oil, to make the surface smooth and soft. The opinion has been advanced that the cases of poisoning from the use of vanilla ice are due to this oil, which is often contaminated with a substance which acts like cantharides. Others suppose the poisoning results from small crystals of benzoic acid found in the outer skin of the vanilla-bean.

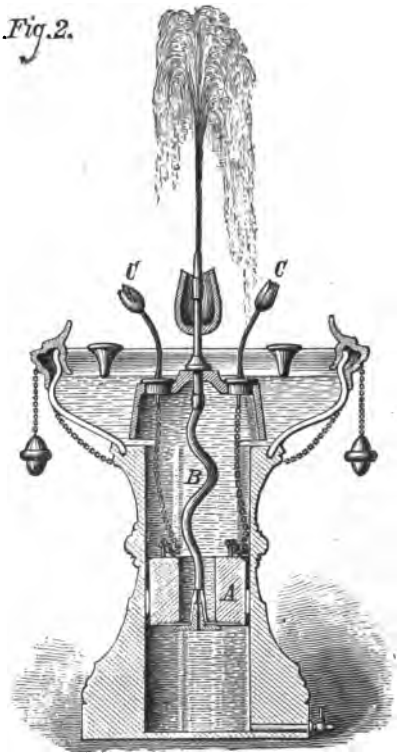
NEW TABLE-FOUNTAIN.

IN our illustrations, Fig. 1 shows the apparatus entire, and Fig. 2 is a vertical section. There is a pedestal, which may be of imitation bronze or any other desired material, and made in any handsome design. In this is a cylindrical space in which fits a heavy plunger A. Through the latter is an opening into which passes a rubber pipe B, of smaller diameter, and which terminates below in a flap-valve. The valve, however, is pierced, so that the opening from the water below, through the pipe and to the spout above, is clear.

Fig. 1

To start the fountain, in which clear, colored, or perfumed water, or even *eau de cologne*, may be used, the plunger is drawn up to the highest position by means of the chains which connect with the movable metal tulip-buds, C. While this is being thus elevated, the water above passes through the annular space between the pipe and the periphery of the orifice in the plunger, and escapes below, the valve, of course, opening downward. The plunger, however, on being left to itself, descends by its own gravity, pressing upon the water below, which, unable to ascend through the annular space on account of the closing of the valve, is forced through the small central opening in the latter, through the pipe B, and finally out at the spout in a fine jet sixteen or eighteen inches high. The basin com-

Fig. 2.



municating with the cylinder, of course, never overflows, and the play of the fountain continues until the plunger has reached the bottom, which, with a small jet, occupies a period of about forty-five minutes. Made by the American Fountain Works, New-Haven, Ct.

PINE-LEAF UPHOLSTERY.—C. E. Ramus, of Lawrence, Kansas, states that a material very suitable as a substitute for hair, feathers, etc., may be made from pine leaves or "needles" by boiling them with lime, soda, potash, or similar chemicals, until reduced to a fibrous state. One of the advantages claimed for this material is that it is an effectual repellant for moths, bed-bugs, fleas, and other insect pests.

THE OSAGE ORANGE.—The *Maclura aurantica*, a familiar shrub from its general use as a hedge-plant, it is now proposed to utilize for other purposes. A decoction of the wood is said to yield a beautiful and very permanent yellow dye. This decoction, carefully evaporated, forms a bright yellow extract, called *aurantine*, which may be used in imparting its color to fabrics. In addition to this coloring matter, the wood of the Osage orange is rich in tannin. Experiments made in Texas represent that hides are tanned quicker with the wood of this tree than with oak-bark. The seeds yield a bland, limpid oil, resembling olive-oil, and which may, in general use, be substituted for it.

PRESERVATION OF MEAT AND OTHER SUBSTANCES.

BY LANJORROIC.—The author finds that 1 per cent of fuchsine added to a solution of gelatine entirely prevents its putrefaction, a quantity prepared in this manner having been kept eleven months without change. A piece of meat wrapped in paper imbued with this prepared gelatine and suspended in a current of air, dried up but did not putrefy. After maceration for 24 hours, this dried muscular fibre was found not to be disintegrated, neither had it any disagreeable odor. The addition of a very minute quantity of aniline-violet, urine, or an infusion of coffee, was also found to prevent its putrefaction entirely. (4)

AN EFFICACIOUS DISINFECTANT.—A writer in the *Chemical News* offers some useful hints on disinfectants, which may be of interest. After a long-continued series of experiments, he pronounces sulphate of aluminium and hydrochlorate of alumina very powerful disinfectants and antiseptics. Their solubility and harmlessness render their use admissible under all ordinary circumstances. The chloride and sulphate of iron have the same action as the above, and, further, they absorb the sulphureted products of decomposition. For this reason, these salts are the most efficacious of disinfectants. But there is one objection to their use—namely, that the iron would injure any vegetation with which the disinfected matter might come in contact. The writer recommends, as the best of all disinfectants, for general use, a solution containing hydrochlorate of alumina, with a small quantity of chloride of iron. The hydrochlorate will do all the work of a disinfectant and antiseptic, while the chloride will absorb the sulphureted compounds.

A. VOGEL has found nearly all specimens of fresh milk either neutral or slightly acid. In only two specimens out of thirty, the alkaline action appears to have been due to traces of free ammonia. He ascribes the acid reaction of fresh milk to the presence of free carbonic acid, since litmus tincture colored red by fresh milk regains its blue color on shaking or boiling. No mention is made of the conditions of food, etc., to which the cows were subject.

THE roof of Westminster Abbey, which was supposed to be of oak, is now found to be of chestnut. Though it has stood for eight centuries, it is still perfectly sound—a fact which speaks well for chestnut timber as a building material. In addition to this quality of resisting decay, chestnut timber possesses also another, namely, that its growth is many times more rapid than that of oak.

THE ART OF FRYING FISH.

SEVERAL kinds of fish are fried when small: such as small trouts or troutlets, carps, tench, sun-fish, pike, pickerel, flounders, white-fish, black and blue fish, perch, porgy, mullet, weak-fish, herring, bass, and the like, and smelts, which never grow above the frying size.

When fish or any thing else is cooked in a frying-pan with just fat enough to prevent it from burning, it is not fried but *sautêd*, there being two very distinct ways of frying. To fry means to cook fish or something else immersed in boiling fat. To *sautê* means to cook fish or something else with just fat enough to merely cover the bottom of the pan; for instance, small fishes are fried, but omelets are *sautêd;* potatoes are fried, but parsnips are *sautêd.*

Many inexperienced cooks make mistakes on that account; they read in some cook-book that such article of food is good fried, and set to frying it when it should be *sautêd*, and *vice versa.*

The fat skimmed from the surface of broth, which is beef-suet, the trimmings of steaks or roasting pieces of beef melted as directed below, are better for frying purposes than lard, not flying all over as lard does.

The fat skimmed from trimmings or from around the kidneys of beef is cut in small pieces, put in an iron pot, and set on a rather slow fire. As soon as it begins to melt, ladle off the melted part and turn it into a stone or crockery jar, which you cover when cold. Put it away in a cool, dry, and dark place. A careful cook never needs lard for frying purposes, but has always more fat than is necessary out of boiling or roasting pieces, and that skimmed on the top of broth, sauces, and gravies. Some cooks will not take the trouble to melt it when the mistress allows as much lard and butter as is asked for.

It is an error to believe that by using much fat to fry, the articles fried will taste greasy; if there is not fat enough in the pan to completely immerse the objects fried, they will certainly taste greasy. It will be the same if the fat is not heated enough. It is heated enough when jets of smoke ooze out of it, or when, on throwing drops of water on it, it makes a crackling noise.

When the fat is hot enough, the article that is to be fried is dropped into it, and stirred gently now and then with a skimmer. When done, it is taken off the pan with a skimmer and turned into a colander, which should rest on a dish or bowl to receive the fat that may drop from it.

If the article to be fried is not completely immersed in the fat, the part not immersed will absorb fat, and, as stat-

ed above, will taste greasy; but if there is fat enough to cover it entirely, the intensity of the heat closes the pores, carbonizing the exterior of the article, as it were, and preventing it from absorbing any fat.

If the articles to be fried be tender and somewhat brittle, they are put in a wire basket or perforated double bottom made for that purpose, and the basket is plunged into the fat. The basket is raised when the articles are fried, and held over the pan to let the fat drop; they are then taken carefully out of it, placed on a dish, sprinkled with salt, and served hot.

When the frying is done, the pan is put away for a few minutes, to allow the particles of solid matter that may be in it to fall to the bottom of the frying-pan; then it is turned into the jar, gently and slowly, so as to retain those particles in the bottom, and it is put away for another time.—*Prof. Pierre Blot in To-day.*

ACTION OF LOW TEMPERATURES ON WINES AND SPIRITS.

By Melsens.—When cognac or rum is cooled to —30°, it can be drunk from a wooden vessel without causing any violent sensation of cold. Below —35° it becomes viscid, syrupy, and often opalescent. At —40° or —50° it solidifies, and in this state it seems to the tongue less cold than an ordinary ice. At —71° it produces a sensation similar to that caused by a liquid just too hot to be borne, and when it is placed upon the dry skin, it causes a slight burn.

When vin ordinaire is submitted to the action of a freezing mixture, the water contained in it solidifies. The liquid portion being separated from the solid by a centrifugal strainer, the solid part is found to contain but a trace of alcohol and organic matter, and develops fungus in a very short time. By using a screw-press, 25 per cent, and in the case of Burgundy 40 per cent of the wine may be thus separated as water. This treatment is recommended as a means of enriching poor wines, and so rendering them capable of preservation. (4)

PRESERVATION OF FOOD BY COLD.

M. Boussingault, of the French Academy, in a communication published in the *Comptes Rendus* states that in the year 1865, he placed for some hours in a freezing mixture having a temperature of —4 deg. Fahr. some beef broth contained in flagons. This broth possesses to-day all the qualities it possessed when first treated with the freezing mixture. Similar results were obtained in the case of the juice of sugar-cane.

PASTE FROM RICE-STARCH.

ONE hundred and twenty grains of rice-starch and twenty grains of gelatine are mixed with two ounces of water, and then heated over the flame of a spirit-lamp with constant stirring. When the milky liquid becomes thick and glassy, the paste is ready. It is kept in a well-closed box, and near an open flask containing spirits of wine. The paste is of excellent quality, and will keep good from eight to fourteen days.

HEATING BUILDINGS.

MESSRS. GRIMM & CORVIN, of Magdeburg, Prussia, propose the substitution in hot-water heating apparatus of a mixture of glycerine with chloride of calcium, or other similar hygroscopic salts, in place of the water ordinarily used. Sufficient of the chloride should be used to make the specific gravity of the mixture equal to 1.40 to 1.45. It is claimed for this compound that less fuel will be used, that there is no danger from freezing, nor trouble from evaporation or sediment, and that the heat can be increased to 300° centigrade, whereby much smaller and consequently less expensive apparatus can be used.

OF surface waters, Professor Newberry observes: There is much apprehension in the public mind in regard to the purity of the water of streams which drain the surface of our own and other countries. Water in itself is a disinfectant, and a large volume of water, when exposed to the air, so rapidly "fines" itself by the oxidation of its organic impurities, that when cooled or settled or filtered to remove its suspended ingredients, the water of most of our streams is even more palatable and wholesome than that taken from wells.

CHIMNEYS are excellent lightning-conductors. In view of which, it is recommended: first, that they be kept clean; then, that all the grates in a house be connected by means of a strong wire, such as is used for telegraphic purposes, with a piece of metal in the earth, or with the iron gas or water-pipes.

THE addition of a small quantity of boric acid to milk retards the separation of cream, and the milk does not become sour when kept several days. Beer also, to which boric acid has been added, does not so quickly become hard.—*A. Hirschberg in Arch. Pharm.*

PROFESSOR ORTON says: The imperfections of the diamond, and in fact of all gems, are made visible by putting them into oil of cassia, when the slightest flaw will be seen.

TRAINING SHEEP-DOGS.

AN old shepherd in Southern California says that you may go over the plains and hills there for miles and see thousands of sheep, but not a man to watch them. Around each flock or band of say a thousand sheep are half a dozen dogs of a peculiar breed—dogs whose progenitors were imported from the sheep-pastures of the old world. These dogs take the entire care of the sheep, drive them out to pasture in the morning, keep them from straying during the day, and bring them home at night. These dogs have inherited a talent for keeping sheep, but the shepherds do not depend wholly on that. They cultivate it in this way—so at least the old shepherd says: "When a lamb is born, it is taken away from the mother sheep before she has seen it, and a puppy put in its place. The sheep suckles the puppy and learns to love it. When the puppy grows old enough to eat meat, it is fed in the morning and sent out with the sheep. It stays with them because it is accustomed to be with its mother, but it can not feed with them. As they get full, the dog gets hungry. At length, impatient to return where it hopes to get another piece of meat, it begins to tease and worry its mother, and finally starts her toward home; the other sheep follow, and thus the whole flock is brought in. If the dog brings the sheep home too soon, or comes home without them, he gets no supper or is punished in some other way. Hence he soon learns when to come, and to see that none of his charge are left behind. These animals are trained by taking advantage of their instincts and appetites."

A GLUE WHICH RESISTS THE ACTION OF WATER.

POTASSIUM dichromate unites with gum, glycerine, glue, etc., forming, when exposed to light, a substance insoluble in water. By adding a small quantity of a solution of potassium dichromate, which has been prepared in the dark to glue, a compound is obtained possessing the cohesive properties of glue, but totally insoluble both in hot and in cold water.

Sausages containing peas were used in immense quantity by the soldiers in the Franco-German war, but a difficulty was experienced in obtaining gut as an envelope for the sausages; parchment-paper was accordingly employed. It was found that ordinary gum would not answer the purpose of joining together the seam, as it could not resist the influence of water. The glue, above described, has been employed with advantage by Dr. Julius Strude

in Hamburg. Three per cent of bichrome is added to the ordinary glue or gelatine solution. The strips of paper joined by this glue are dried quickly and exposed to light till the glue changes to a brownish color; they are then boiled with water containing 2–3 per cent of alum till all potassium dichromate is extracted, and then washed in cold water and dried.

ZINC-CAPS FOR BOTTLES, FLASKS, ETC.

By G. C. WITTSTEIN.—These are so greatly contaminated with lead that their composition in many cases would be most correctly expressed in saying that they consisted of lead containing zinc, rather than the reverse. The amounts of lead in caps covering champagne, liqueur, mustard, mineral water, and beer flasks, were respectively 90.13, 91.33, 92.4, 93.1, 94.2 per cent. The danger is particularly great in the case of flasks containing liquids with free acids present, as, if they are not completely emptied at once, and the cap replaced while a portion of the liquor remains, a drop or two of the slightly acid fluid is liable to come in contact therewith, and on standing to act upon the lead, bringing a portion into solution. The drop or two of lead solution on the cap is thus likely to be carried into the stomach of the next drinker from this flask. Cases of acute lead-poisoning have thus been occasioned. The author has also detected lead largely present in tin-foil used to wrap cheese in. (36)

PRESERVATION OF ORGANIC SUBSTANCES.

M. LAUJORROIS communicates to the French Academy the following method for preserving organic substances. It consists in adding to the material to be preserved a minute quantity of fuchsine, barely one hundredth part. A vessel filled with gelatine in solution, to which fuchsine had been added eleven months before, was exhibited by the inventor, and although the receptacle had remained open to the atmosphere, its contents were unchanged. Pieces of beef enveloped in blotting-paper soaked with gelatine and fuchsine were found to keep unaltered, the fibres of the meat only becoming somewhat tough and presenting the appearance of gutta-percha. By maceration in water for twenty-four hours, the beef became perfectly fresh and furnished a soup in which no disagreeable flavor could be detected. Coffee and other substances were experimented upon with similar good results.

TO REMOVE PAINT.—Chloroform will remove paint from a garment or elsewhere, when benzole or bisulphide of carbon fails.

METHOD OF DISTINGUISHING PURE GROUND COFFEE FROM COFFEE SUBSTITUTES.

By J. Muller.—A sample of coffee adulterated with roasted corn or the like, especially substances containing starch-flour, is tested as follows: A small quantity of the powdered coffee is shaken with dilute potash solution, filtered, and the solution diluted with much water; a little iodine solution is now added, when the starch reaction at once ensues if these adulterants be present.

MUSICAL BLACKBOARD.

To facilitate the teaching of the elements of music to young scholars, Messrs. Thomson & Cordley, of Adrian, Mich., provide blackboards with staves having notes, which are, in fact, keys connected with properly tuned reeds, so that the teacher may, in pointing out any particular note, press on the appropriate key and thus produce the proper sound of such note.

A WARMING SEWING-MACHINE-TREADLE.

For the convenience of ladies troubled with cold feet, Annie R. Bush, of Chicago, suggests that the sewing-machine treadle be made in the form of a box, and provided with a hinged cover, in which may be placed a heated iron, so that a person sitting at the machine will be able to keep her feet warm, whether operating or not.

A New Furniture Polish.—A recently patented compound is prepared as follows: Take 2 gallons raw linseed-oil, 1½ gallons turpentine, ¼ pound dragon's blood, ¼ pound rosin, ¼ pound alum, 2 ounces iodide potassium, ½ pound sulphuric acid, 8 ounces nitric acid; using avoirdupois weight for the dragon's blood, rosin, alum, iodide potassium, and sulphuric acid; common wine or liquid measure for the oil and turpentine; apothecaries' measure for the nitric acid. First, put the oil and turpentine into an earthen vessel; then pulverize the dragon's blood, rosin, alum, and iodide potassium to a fine powder. Stir this powder slowly into the oil and turpentine; then add the sulphuric acid slowly, stirring continually. Let this mixture stand ten hours, then add the nitric acid. Slowly stir the mixture while adding. Apply with a sponge or cloth. (63)

Squeaking Boots and Shoes.—To prevent the soles of boots or shoes from squeaking, says the *Shoe and Leather Chronicle*, rasp, with a coarse rasp, the outsole and insole, and every other piece of leather that comes in contact in friction by the action of the foot. Then apply freely good wheat or rye paste. If this is well attended to from heel to toe, the boot or shoe will not squeak.

A NEW USE FOR SULPHITE OF LIME.

THIS salt has long been used with remarkable success in preserving cider sweet, and preventing fermentation in wines, beer, and canned fruits and vegetables. Professor Church, of England, the eminent agricultural chemist, announces that sulphite of lime appears to exercise a very decided influence in arresting the spread of decay in potatoes affected by the potato disease. In one experiment, the salt was dusted over some tubers, partially decayed from this cause, as they were being stowed away. Some months afterward, the potatoes were found to have suffered no further injury. A similar trial with powdered lime proved to be much less effective. When sulphite of lime is brought in contact with fermentable matter, it undergoes decomposition, and sulphurous acid is liberated, which instantly destroys vitality in the budding ferment, or spores, and thus arrests the process of change or decay. (63)

CAUTION ABOUT THE HANDLING OF PARIS GREEN.

The Paint and Oil Trade gives the following cautionary suggestions, penned by a member of one of the leading firms in the paint trade in this city:

As the handling and using of dry Paris green, especially by persons unaccustomed to its use, is attended with considerable risk, and often followed by serious consequences, we make the following suggestions, founded on our experience as manufacturers:

PREVENTIVE PRECAUTIONS.—All packages, whether large or small, should be plainly marked *poison*.

There is great danger in the mixing of this green for potato-bug and cotton-worm poison, owing to the fine dust which arises in the process, which is inhaled, and also rapidly absorbed by the pores of the skin, especially if the person using it should be in a state of perspiration. To guard against this, the hands and face, particularly the nostrils, should be protected as much as possible, and should be carefully washed after working in it, or in any of the preparations of which it is an ingredient. As it penetrates and poisons wood, gets into the seams and crevices of articles made of metal, and even into earthenware that is at all porous, all household utensils, or any thing in barn or stable, which cattle or horses could have access to, in which the article may have been mixed, or from which it has been used, should be carefully set aside, and never again used for any other purpose.

Malignant sores are not infrequently caused by scratching the skin when itching, or irritated, from handling the

green. It should be constantly borne in mind that it is a more dangerous and deadly poison than arsenic, and farmers, planters, and others, when purchasing, should be duly cautioned to exercise the utmost care in using it.

CURE.—The free use of milk as a beverage is recommended; but we have found hydrated peroxide of iron (a simple, harmless remedy) the best antidote. Sores caused by the green should be well covered with it, as with an ordinary salve, and a teaspoonful in a wine-glass of water should be taken twice a day, internally, while working with the green. This remedy can be obtained from any druggist or chemist.

To be effective, the hydrated peroxide of iron must be kept in closely corked bottles, and excluded as much as possible from light and air.

The consumption of Paris green has vastly increased within a few years, and the article is now applied to such a variety of purposes that carelessness in its use, or ignorance of its highly dangerous properties on the part of those who use it, can not fail to produce the most deplorable results. In view of this, we feel impelled, in the interests of humanity, to issue this circular, and to give it the greatest possible circulation. (105)

PRESERVING MILK.

IT is stated by L. F. Kirchhofer, of Union Hill, N. J., that if milk before it has lost its natural heat be gradually raised in temperature to from 160° to 170° Fahr., and kept at that from one hour to five, in closely stoppered bottles, it will, without the admixture of any foreign substance, remain unchanged from one month to a year, according to the length of time it was heated. If the above degree of heat is exceeded, the milk will have a "cooked" taste, but if kept at that temperature for the proper length of time, it will retain, it is said, its natural taste and flavor.

GLASS SHIRT BOSOMS.

A NOVEL idea, although doubtless impracticable in the present state of the art, is shown in the proposition of Asa Johnson, of Brooklyn, N. Y., to make the above of glass moulded to the required shape, or by dipping wire-cloth of the proper form into melted glass.

WIRE WALLS FOR BUILDINGS.

THEODORE HYATT, of New-York, proposes the use of walls formed of corrugated wire-gauze, covered upon both sides with a plastic material composed of asbestos combined with earthy matter, or of blocks formed of gauze frames covered with a similar compound.

FERTILIZATION OF FLOWERS.

MR. MEEHAN last year exhibited, at the Philadelphia Academy of Natural Sciences, a pear having fibrous instead of granular flesh, and a tough rind like that of the apple. He accounted for these phenomena by the theory that apple-pollen had impregnated a pear-pistil. At the meeting of the Academy held January 21st, he exhibited an ear of Indian-corn which serves to confirm his hypothesis. As soon as the "silk," that is, the pistils, appeared, the pollen in the "tassel" of a quite different variety of corn was set in a bottle near it, the plant's own tassel having been cut away some time previously. Soon this tassel was taken away, and replaced by another of a different species. The result was that *each grain* bore a resemblance to the grain of the two impregnating plants, the base having the color of the one, and the upper half the color of the other. Thus it is seen that one ovule may receive an impress from the pollen-grains of at least two separate plants, even though a considerable time intervene between the first and second impregnation.

ASBESTOS ARTIFICIAL STONE.

IT has been suggested by J. J. Bartlett, of New-York, that a fireproof and slightly elastic building block may be made by reducing asbestos to fibre, and mixing with it a sufficient quantity of silicate of potash or soda, to produce a plastic mass, which may be then pressed into moulds. After the block is set, it is saturated with chloride of calcium, either pure or mixed with chloride of magnesium, and afterward washed in water to remove the soluble chlorides.

CISTERNS.

IN order to furnish a portable temporary support for the covering arch during its formation, and one that can be readily removed through the hole left in the centre thereof when finished, Joseph Cruger, of Indianapolis, Ind., proposes to make such supports in the form of an umbrella-frame, but with the fastening on the upper side thereof instead of below, as in umbrellas, etc., so that the frame may be readily closed and withdrawn from the top of the cistern.

SUBSTITUTE FOR COFFEE.

IT is stated by Edward Dugdale, of Griffin, Ga., that a substance resembling coffee in appearance and taste may be made by separating the seeds from the pulp of persimmons, cleansing them, and afterward roasting and grinding in the same manner as coffee.

ICE FOR KEEPING FRUITS.—A correspondent of *The Field* relates his experience in keeping fruits and vegetables in an ice-house. He says: "I lay them upon cotton, in tin boxes (biscuit boxes will do) without any packing about them, shut down the lid, and set the boxes on the ice, not buried in it. Peaches I have kept quite a month in this way after they were dead ripe, and nectarines six weeks. I place them in shallow tin boxes, putting a piece of cotton between the fruits, but otherwise leaving them uncovered. After they have been long on the ice, they should not be brought out long before they are used, as they do not keep long afterward without showing specks. Tender-fleshed melons, that will not keep a week in the fruit-room in summer, will keep three or four weeks in the ice-house. Cucumbers will keep a very long time, and I have known the autumn and winter supply greatly prolonged by storing them away in boxes in the same way as fruit. French beans should be packed in bundles and set on their ends in boxes. (63)

KEEPING APPLES.—A correspondent of the *Cultivator* states that he kept 1200 bushels of apples, mostly Baldwins, through the past winter and spring in his cellar. He claims that by his mode, apples may be kept the year round, without losing their juiciness or crispness. His theory is, that the early rotting and decay of apples is due, to a great extent, to a vegetable miasma in the air which is communicated to it by vegetable evaporation under certain conditions. The effect of this miasma is first seen in a minute speck; sometimes as many as a dozen may be counted on the same apple. His remedy is a daily airing of the cellar or place where the apples are stored, arranging so as to have a brisk circulation, until all the stagnant air is expelled, and its place occupied by pure air. His success proves that his views are at least worthy of consideration.

ARTIFICIAL RAIN.—Isaac Brown's novel system of shower irrigation applied to pasture at Stoke Park, near Slough, consists in forcing water through small perforations in lead pipes, by means of a powerful force-pump. The lead pipes are laid down 16 yards apart; a 12 horse-power engine works a force pump; with a pressure of 60 or 70 lbs. per square inch, or a head of 120 or more feet, the engine maintains a shower upon a plot of about an acre and a half, applying 10 tons of water in 15 minutes. Plot after plot is watered in rotation, the work taking place principally in the night.

MATERIA MEDICA, THERAPEUTICS, HYGIENE.

THE SKIN.

THE skin is composed of two layers, an outer, called the cuticle or scarf skin, or sometimes termed the *epidermis*; and an inner, called the *cutis* or true skin, or sometimes the *dermis*. This latter rests upon a very fine interlaced or netted structure called the *areolar tissue*, out of which, if we may so express it, the granules and fibres of the skin are formed. Most of the popular descriptions of the skin describe a third layer, called the *rete mucosum*; but later researches have shown that there is no such distinct layer, and that the pigment-cells to which the color of the skin of different races is due, are but a different stage in the development of the scarf skin. The cuticle at the surface consists of several layers of laminated scales, the laminated form being best marked at the very surface, where the scales are constantly falling off as a kind of scurf, and are as constantly being renewed from below. These scales are about 1-3000th of an inch in diameter. Man is a "scaly" animal in more senses than one, for he is at all times as literally covered with scales as are the fishes and reptiles. The scales of these lower creatures are but modified forms of the epidermal scales which cover the human body, and so in this particular we are linked with the snakes and lizards. We differ in one important respect from these creatures, as we drop our scales gradually, while theirs are removed at one particular season, and come off *en masse*. Into the epidermis no nerves or blood-vessels enter; it serves as a protective coating to the delicate true skin and areolar tissue below. No part of the body has a more exquisite nervous sensitiveness than the true skin, and this is necessary to give delicacy to the sense of touch. This is a kind of exalted form of general sensation, and resides especially in the skin. It is as wonderful as the sense of taste, sight, or hearing, and yet how seldom is it spoken of in connection with the other senses! If we look at the skin of the hand with a microscope, we notice that there are delicate grooves crossing the furrows, which can be seen with the naked eye. In the centre of each of these is a small orifice, a little microscopic canal, which is of more importance to the welfare of the body than the mouth, or any other orifice found in the human organism. This is one of the many millions of perspiratory ducts which

everywhere dot the skin, and through which effete and worthless matter is removed from the system. Underneath the ducts, deep in the true skin, are little glands, furnished with a minute capillary net-work of blood-vessels, which bring to the surface the worthless and poisonous agents which the interior organs reject, and the ducts pour them out into the clothing, mixed with the perspiratory matter. From this simple statement we learn why the functions of the skin are so important. It is obvious that waste matter must have unobstructed channels through which to pass, and hence we learn that it is our duty, since they are for wise reasons placed under our control, to keep them in a free and healthy condition. We also learn that it is hazardous to expose these ducts and these delicate nerves of the skin to undue extremes of temperature; that we must guard against sudden changes, avoid chills, avoid draughts of air, avoid all those external agents, of whatever form or nature, which are calculated to disturb or disorganize the free performance of the functions of the skin. (63)

THOUGHT THE PRODUCT OF CHEMICAL CHANGE.

By Dr. William B. Carpenter, LL.D., F.R.S.—The tendency of modern physiology is to prove the existence of a distinct *causal* relation between physical changes in the nervous system and definite modes of mental action, and it may be well for me to adduce, *in limine*, the positive evidence that *all* mental activity is dependent on a chemical reaction between the blood and the brain; for, although this is one of the best-established facts in physiology, it is, I believe, taken very little account of by metaphysicians. The brain is supplied with blood by four arterial trunks, which enter the cranial cavity at no great distance from one another, and then unite into the "circle of Willis;" from which are given off the various branches that distribute arterial blood to every part of the brain-substance. After traversing this, the blood returns by the veins, greatly altered in its chemical composition; especially as regards the loss of free oxygen, and its replacement by various oxy-compounds of carbon, hydrogen, phosphorus, etc., that have been formed by a process analogous to combustion. Now, if one, two, or three of the arterial trunks be tied, the total supply of blood to the brain is diminished; but, in virtue of the "circle of Willis," no part is entirely deprived of blood; and the functional activity of the brain is still maintained. If, however, the *fourth* artery is compressed

so as to prevent the passage of blood, there is an *immediate* and *complete* suspension of activity; the animal becoming as unconscious as if it had been stunned by a severe blow, but recovering as soon as the blood is again allowed to flow through the artery. Further, if the blood transmitted to the brain, though not deficient in quantity, be depraved in *quality* by the want of oxygen and the accumulation of carbonic acid, (as happens in asphyxia,) there is a gradually increasing torpor of the mental faculties, ending in complete insensibility.

Thus the dependence of mental activity of even the most elementary kind, upon the physical changes kept up by the circulation of oxygenated blood through the brain, can be shown experientially to be just as direct and immediate as is the dependence of the electric activity of a galvanic battery upon the analogous changes taking place between its metals and its exciting liquid. If we say that electricity is the *product* of chemical change in the one case, I see not how we can refuse to regard thought as the *product* of chemical change in the other; nor (in the view that all the forces of nature are simply expressions of mind) do I see that we need entertain any repugnance to such a view. I do not say that it *explains* any mental phenomenon. No sound physicist would say that he can "explain" how it is that electricity is generated by chemical change; but he knows that such a relation of cause and effect exists between the two orders of phenomena, that every chemical change is accompanied by an electric disturbance; so that, whenever he witnesses electric disturbance, he looks with assurance for some chemical change as its physical cause. And, in precisely the same sense, and in no other, I affirm that the physiologist *must* regard some change in the nervous substance of the brain as the immediate physical cause of all *automatic* mental action. If this be admitted of sensational consciousness, (and how can it be denied?) we can scarcely help admitting it of emotional; and if of emotional, why not of ideational?

One of the most remarkable results of recent pathological research has been the discovery of the dependence of the condition termed *aphasia*, or "loss of memory of words," upon malnutrition of a certain part of the cerebrum; and the tracing of this malnutrition back to an interruption in the supply of blood. In this curious mental infirmity which often begins to show itself before there is any other evidence of cerebral disorder, but which is now recognized as a most serious indication of impending mischief, the subject either forgets the words he wants for expressing

his ideas, or he uses *inappropriate* words in their place. It is obvious that he *knows* what he wants to express, but can not recall the words in which to convey that knowledge to others. There is no paralysis of speech, for his articulation is quite unaffected; so that he can repeat the words he wants, if they are suggested to him by others. In a case formerly under my observation, the aphasia went on gradually, but very slowly increasing, for three or four years; showing itself at first as to only a few out-of-the-way words, but gradually increasing until no intelligible language seemed to be left, except that of swearing, which came forth in a torrent when any restraint was put on the patient's bodily activity, which continued very energetic until near the close of life. In another case, recently mentioned to me by a medical friend, who was a near connection of the patient, the disease ran its course in a few months. Cases of this kind almost invariably terminate in apoplexy. Now, it may be said that we have here only the evidence of *synchronous* disease of the brain and disorder of the mind; so that the *dependence* of the latter upon the former is not made out. But the very curious discovery was made a few years ago, by Dr. J. Hughlings Jackson, that the locally impaired nutrition of the brain in these cases is usually attributable to "embolism," of the middle meningeal artery, whereby the passage of blood through it is greatly impeded; this "embolism" consisting in the plugging of the artery by a fibrinous clot brought from the heart, where it has been produced by valvular disease. In the second of the cases just referred to, the usual brain-lesion having been found and the middle meningeal artery having been examined, the *fons et origo* of the mischief was found to be, not "embolism," but a morbid deposit on the inner wall of the artery, producing a corresponding obstruction to the circulation. Looking, then, to the fact that *immediate* cessation of mental activity is distinctly and unmistakably produced by the *entire* suspension of blood circulation through the brain, how can the physiologist refuse to recognize in this *local* reduction of the circulation the physical cause of that *limited* reduction of psychical activity which so distinctly follows it?

But further, this singular fact, taken in connection with the recent great extension of our knowledge as to the local alterations in the calibre of the arteries, which are produced through the "vaso-motor" system of nerves, obviously points to the probability that the *limited* but *transient* lapses of memory just alluded to are due to a local reduction of the blood-supply in the part of the cerebrum which ministers to the lost function; and that the *sudden*

recovery which sometimes occurs is the result of the renewal of the normal circulation, through the giving way of the impacted clot, or the yielding of the spasmodically constricted arterial wall.

Thus Dr. Rush, of Philadelphia, was acquainted with a person of considerable attainments, who, on recovering from a fever, was found to have lost all his acquired knowledge. The automatic play of the "mechanism of thought" does that which volition is unable to effect. Whether it be the *toxic* condition of the blood, or the simple excitement of the cerebral circulation generally, or the special direction of blood to a particular part of the brain, it is beyond our present power to tell; but, as *all* brain-change is (like the action of any other mechanism) the manifestation of force, the production of these *unusual* mental phenomena, by the instrumentality of an unusual reaction between the blood and the brain-substance, is no more difficult of comprehension than that of *ordinary* forms of psychical activity, which we have seen reason to regard as the results of the translation (so to speak) of one form of force into another.

The intimacy of the relation between the psychical phenomena of memory and physical conditions of the brain is further shown, by the effect of fatigue and the impaired nutrition of old age in *weakening* the memory, and of disease and injury of the brain in *impairing* or *destroying* it. Every one is conscious of the difference in the activity of the reproductive faculty in which memory consists, according as his mind is "fresh," or his head feels tired." The latter state, in which the automatic activity and the directing power of the will are alike reduced, is clearly dependent, like the feeling of muscular fatigue, on the deterioration of the organ, or of the blood, or of both combined, which results from the prolonged exercise of it: and it is especially in our inability to *recollect* something which we *wish* to call to mind, that this failure of power shows itself. An interval of repose completely restores the power, obviously (to the mind of the physiologist) by the renovation of the worn-out brain-tissue, and by the purification of the blood that has become charged with the products of its "waste."

The direct causal relation of physical conditions to mental states may be made still more clear by following out into some detail the phenomena of that peculiar form of intoxication which is produced by *hashish*—a preparation of Indian hemp used in the Levant for the purpose of inducing what is termed the *fantasia*. The action of this drug was very carefully studied some years ago by M. Mo-

reau, physician to the Bicêtre, who had given great attention to the psychology of insanity, and whose special object was to throw light upon that subject by experimenting upon what he termed its artificial production.

One of the first appreciable effects of the *hashish*, as of other intoxicating agents, is the gradual weakening of that power of *volitionally* controlling and directing the current of thought, the possession of which characterizes the vigorous mind. The individual feels himself incapable of fixing his attention upon any subject; the continuity of his thoughts being continually drawn off by a succession of disconnected ideas which force themselves (as it were) into his mind, without his being able in the least to trace their origin. These speedily engross his attention, and present themselves in strange combinations, so as to produce the most impossible and fantastic creations.

It is another characteristic of the action of *hashish* that the sucession of ideas has *at first* less of incoherence than in ordinary dreaming, and the ideal events do not so far depart from possible realities; the disorder of the mind being at first manifested in errors of sense, in false convictions, or in the predominance of one or more extravagant ideas. These ideas and convictions are generally not altogether of an imaginary character, but are rather *suggested* by external impressions, these impressions being erroneously interpreted by the perceptive faculties, and giving origin, therefore, to fallacious notions of the objects which excited them.

"We become," says M. Moreau, "the sport of impressions of the most opposite kind; the continuity of our ideas may be broken by the slightest cause. We are turned, to use a common expression, by every wind. By a word or a gesture, our thoughts may be successively directed to a multitude of different subjects with a rapidity and a lucidity which are truly marvelous. The mind becomes possessed with a feeling of pride corresponding with the exaltation of its faculties, of whose increase in energy and power it becomes conscious. It is seldom that the excitement produced by the hashish fixes itself upon any particular train of ideas, and gives rise to a settled delusion; for in general one set of ideas chases another so rapidly that there is not time for either of them to engross the attention of the intellect; more especially since (as already remarked) there is usually such a degree of self-consciousness preserved throughout, as prevents the individual from entirely yielding himself up to the suggestions of his ideal faculties.

Here, then, we have an extraordinary *exaltation* of the automatic action of the brain, manifesting itself in the

rapidity and intensity of the current of thought; while the controlling power of the will is not only relatively, but *absolutely* reduced. And this modification of the normal form of mental activity is clearly referable to the perversion of the normal action of the blood upon the brain, which is due to the introduction of a new physical agent into the former. The production of errors of perception, arising from the tendency to *magnification* of the impressions actually made on the senses, is a peculiarly interesting feature of this perversion which is clearly a *mental* misinterpretation not at all corresponding to the double vision of the drunken man, which is an error of *sense* arising from the temporary want of adjustment of the axes of the eyes. And with this magnification there is connected a sentiment of *happiness* which attends all the operations of the mind.

"It is really *happiness*," says M. Moreau, "which is produced by the hashish; and by this I imply an enjoyment entirely moral, and by no means sensual, as we might be induced to suppose. This is surely a very curious circumstance, and some remarkable inferences might be drawn from it; this, for instance, among others, that every feeling of joy and gladness, even when the cause of it is exclusively moral—that those enjoyments which are least connected with material objects, the most spiritual, the most ideal—may be nothing else than sensations purely physical, developed in the interior of the system, as are those procured by the hashish. At least, so far as relates to that of which we are internally conscious, there is no distinction between these two orders of sensations, in spite of the diversity in the causes to which they are due; for the hashish-eater is happy, not like the gourmand or the famished man when satisfying his appetite, or the voluptuary in gratifying his amative desires; but like him who hears tidings which fill him with joy, like the miser counting his treasures, the gambler who is successful at play, or the ambitious man who is intoxicated with success."

Most persons will be able to recall analogous states of exhilaration, and the reverse condition of depression, in themselves; the former being characterized by a feeling of general well-being, a sentiment of pleasure in the use of all the bodily and mental powers, and a disposition to look with enjoyment upon the present, and with hope to the future; while in the latter state there is a feeling of general but indefinable discomfort. Every exertion, whether mental or bodily, is felt as a burden; the present is wearisome, and the future is gloomy.

Now, there are many persons in whom these opposite emotional states are induced by meteorological condi-

tions; the one by a dry, clear, bright atmosphere; the other by that close, damp, "muggy" state of the air, which seems to lay a "wet blanket" upon all their enjoyment, both bodily and mental. And precisely the same depressing influence is often experienced from deficient action of the liver, causing an accumulation of the materials of bile in the blood; and it is just as apparent to the physician that the elimination of these by appropriate remedies, so as to restore the blood to its normal purity, thereby removes the moral *depression*, as it is that the introduction of a minute quantity of hashish into the blood produces a moral *exaltation*.

In these days of eager competition, again, it is extremely common for a psychical state to be induced by the overtasking of the brain, which every intelligent medical practitioner recognizes as essentially physical in its origin, but which yet manifests itself chiefly in moral, and not unfrequently, also, in intellectual perversion. The excess of activity is followed, as its natural result, by a state of depression; in which the subject of it looks at every thing, past, present, and future, in a gloomy light, as through a darkened glass. His whole life has been evil; he has brought ruin on his affairs; his dearest friends are in league to injure him. At first this moral perversion extends itself only to a misinterpretation of actual occurrences, which only differs in degree from that which we observe in persons of a morose temper. But, with the advance of the disorder, the mind dwells on its own morbid imaginings, till they come to take the place of actual facts; and in this way *hallucinations* are generated—that is, creations of the imagination, which are accepted as real occurrences. Now, here there is no primary intellectual perversion; the reasoning powers are not disturbed; the patient can discuss with perfect sanity any question that does not touch his morbid feelings; but the representations shaped by his own mind, under the influence of these feelings, being received as truths to the exclusion of his common-sense, all his actions are based on those erroneous data. This condition is merely an intensification of that just described; and the physician can no more doubt that it depends upon an unhealthy condition of the bodily frame, than that the delirium of fever and the fantasia of hashish are dependent upon the presence of a poison in the blood.

The psychologist who neglects such phenomena as these, merely because the inferences drawn from them by the physiologist have a dangerous flavor of "materialism," seems to me just as blameworthy as the physiolo-

gist who ignores the facts of consciousness, when they do not happen to fit in with his own conclusions. The true psychologist is he who lays the foundations of his science broad and deep in the *whole* constitution of the individual man, and his relations to the world external to him; and aims to build it up with the materials furnished by experience of every kind, mental and bodily, normal and abnormal; ignoring no fact, however strange, that is attested by valid evidence, and accepting none, however authoritatively sanctioned, that will not stand the test of thorough scrutiny. (102)

THE PHYSIOLOGY OF DEATH.

WHEN the heart has definitely ceased to beat, then resurrection is no longer possible, and the life is preparing to enter upon a new cycle.

Hamlet in his famous soliloquy, speaks of "that undiscovered country from whose bourn no traveler returns," and mournfully asks, what must be the dreams of the man to whom death has opened the portals of those gloomy regions? We can give no clearer answer, in the name of physiology, than Shakespeare's prince gives. Physiology is dumb as to the destiny of the soul after death; of that it teaches, and it can teach us, nothing. It is plain, and it would be childish to deny it, that any psychical or sentient manifestation, and any concrete representation of the personality, are impossible after death. The dissolution of the organism annihilates surely, and of necessity, the functions of sensation, motion, and will, which are inseparable from a certain combination of material conditions. We can feel, move, and will, only so far as we have organs for reception, transmission, and execution. These assurances of science are above discussion, and should be accepted without reserve. Do they tell us any thing of the destiny of the psychical principles themselves? Again we say, No, and for the very simple reason that science does not attain to those principles; but metaphysics, which does attain to them, authorizes us, nay, further, compels us to believe that they are immortal. They are immortal, as the principles of motion, the principles of perception, all the active unities of the world, are immortal. What is the general characteristic of those unities? It is that of being simple, which means being indestructible, which means being in harmonious mutual connection, after such a manner that each one of them perceives the infinite order of the other. If this connection did not exist, there would be no world. What is the characteristic of the psychical unities more

especially? It is that of having, besides the consciousness of such perception, the feeling also of the relations that bind the whole together, and those faculties, more or less developed, which that consciousness and that perception imply. But why should these unities be any more perishable than the others? Why, if all these forces, all these activities, are eternal, should those alone not possess eternity which have this high privilege, that of knowing the infinite relations which the others sustain without knowing that they do so?

To form a conception of the immortality of the soul, then, we must place ourselves at that point of view to which men rarely and hardly rise, of the simplicity and the indefectibility of all those principles of force that fill the universe. We must train ourselves to understand that what we see is nothing in comparison with what we do not see. The whole force, the whole spring, of the most complex movements, the most magnificent phenomena of nature, and the most subtle operations of life, thought included, proceed from the infinite commingling of an infinity of series of invisible and unextended principles, whose activities ascend in the scale of perfection from simple power of movement up to supreme reason. Human personality, such as we see and know it, is only a coarse and complex result from those of these primitive activities which are the best and deepest thing in us. It is not that personality which is immortal—that is no more immortal than the motive force of a steam-engine is, or the electricity of a voltaic battery, although movement and electricity are of themselves indestructible. It is not that personality which can aspire to a home in the bosom of God. Our true personality, our real *I*, that which may without illusion count on a future life, is unity released from every material bond, and all concrete alloy; it is that force, necessarily pure, which has a more or less clear consciousness of its own relations with the infinity of like unities, and which more or less draws near to them by thought and by love. It is beyond our power to conceive what will become of that unity when, quitting its prison of flesh, and soaring into the ideal ether, it will no longer have organs with which to act; but what we can affirm is that, precisely by reason of this freedom, it will rise to a clearer knowledge of all that it had only known obscurely, and to a purer love of what it had adored only through the vail of sense. And this certainty, which is the ennobling and elevating force of life, is also the consolation for death.—*F. Papillon.* (87)

SOUNDS OF THE BODY.

AT a recent meeting of the Clinical Society of London, Dr. Poore exhibited an adaptation of a well-known philosophical experiment to medical purposes. A patient with a remarkably loud aortic regurgitant murmur, accompanied by intense thrill, was made to lie on his back upon a common mahogany table. Dr. Poore then took an ordinary walking-stick, placing it vertically upon the sternum at the level of the third costal cartilages, and upon the upper end he poised the sounding-board of a guitar, with the orifice downward. When this arrangement was completed, and after complete silence had been obtained, the murmur became distinctly audible to the bystanders. Dr. Poore remarked that he regarded the case merely as a clinical curiosity. His apparatus was very rough, but it served to exhibit a novel application of acoustic principles, and probably, with a specially constructed and more delicate instrument, it would be possible to render the sounds and murmurs of the heart audible for the purposes of clinical demonstration. Sounds and probes with sounding-boards at one end were used in some of the clinical lecture theatres in Germany; and Dr. Poore exhibited an iron probe with a circular sounding-board at its extremity, by means of which all vibrations communicated to the probe were greatly intensified.

Mr. De Morgan remarked that Dr. Corfe had suggested the converse of this. He demonstrated that, when a person placed his head on his chest, the sound of his voice, when speaking, was affected by the condition of the patient's chest.

Dr. Anstie remarked that Mr. Brooke used to demonstrate stone in the bladder to his class at the Westminster Hospital, by means of a sounding-board attached to the staff.

The application of this well-known phenomenon of the transmission of sound to the diagnosis of chest-diseases may possibly lead to a material improvement upon the stethoscope. A walking-stick is, of course, not the most suitable connecting-rod for conducting the sound.

EXHALATION OF CARBONIC ACID BY MAN.

SOME interesting researches on the quantity of carbonic acid exhaled in a given time from the skin of a man, have been conducted by Herr H. Aubert and his assistant, Herr Lange, and have appeared in Pfluger's *Archiv für Physiologie*. The experiments have been carefully made in an air-tight chamber, in which the subject for experiment was seated, and through which a current of air, freed from

carbonic acid, was steadily passing, while the proportion of carbonic acid in the air on leaving the chamber was estimated by transmission through bulbed tubes containing a solution of a salt of barium. The results of these investigations lead to the general conclusion that sixty-two grains of carbonic acid are exhaled from the body of a full-grown man, through the skin, in the course of twenty-four hours.

ON THE PURIFICATION OF DRINKING-WATER.

By WILLIAM CROOKES, F.R.S., ETC.—During the past year, the British government made war upon the Ashantee tribes of the Gold Coast of Africa, in punishment for a series of long-continued outrages. Operations were commenced by the sending out of a large military force. The portion of Africa where the landing took place was noted for the insalubrity of its climate, from which the army suffered severely. At the request of the Medical Department of the British army, Dr. Crookes, editor of *The Chemical News*, prepared the following lucid and valuable memorandum, which is full of most useful information.

In the absence of any specific information as to the quality of water likely to be found on the Gold Coast, the following remarks are necessarily somewhat general in character.

Disinfection of water can not be effected by one substance which removes all the evils at once. There are likely to be many septic bodies in various conditions, and each has to be attacked in a special way.

The danger certainly lies in the organic matter present in the water; but it bears no constant relation to the quantity present. Water may contain a large quantity of peaty organic matter—as much as four or five grains to the gallon—and be harmless; whilst a very small fraction of this quantity of another kind of organic matter may make it a deadly poison.

MALARIOUS SOILS.

Malaria appears to be caused by the decomposition of organized bodies. Soils generally are acid, and the drainage-waters from them are comparatively harmless. But, under conditions which are frequently likely to obtain in a tropical country—such as great heat, low-lying position, damp, marshy soil, exuberant and dense vegetation preventing access of solar rays to the soil—the soil is likely to become more alkaline than the vegetation will bear; putrefactive decomposition will commence, the oxygen in solution in water will be insufficient to restore the bal-

ance, and malaria will be the result. In the drainage water from such a tract of country the germs of fatal diseases are almost certain to be present—to what extent we are ignorant.

FEVER-POISON IN WATER.

That the poison is in the water rather than in the air is well illustrated by a circumstance related by Dr. Woods, (*Chemical News*, vi. 307.) Two ships were dispatched simultaneously with troops from Algeria to France, both under similar circumstances, excepting that the supply of water had been drawn in one case from the low marshy lands where ague was prevalent, whilst the other ship had taken water from a locality situate at a greater elevation, and where the disease was unknown. The passengers on board the first transport were quickly seized with remittent fever, whereas no case of illness occurred on board the second vessel.

ACTION OF PERMANGANATE OF POTASH IN PURIFYING WATER.

The means relied upon for destroying or neutralizing the poison in bad water are, with the general public, addition of permanganate of potash, and filtration through charcoal.

For general purposes, these may be sufficient; but in cases of real difficulty, they are likely to be most unsafe, if not positively harmful as leading to a fancied security.

Permanganate of potash exerts extraordinary destructive powers on some kinds of organic matter. Thus the offensive gases of putrefaction are at once deodorized, and many kinds of organic matters, such as oxalic acid, sugar, etc., are almost instantly destroyed. With other substances, however, such as the scent of musk, urea, (from urine,) the strong-smelling valerianic acid, lactic acid, (from sour milk,) and butyric acid, (from rancid butter,) permanganate of potash has little action, and it has not much effect on strychnine, and some other violent poisons.

If we divide the organic matter in water into three classes, namely:

(1.) Matter already in a state of putrefaction,
(2.) Matter ready to become putrid,
(3.) Matter which is slow to decompose,

it will be found, *practically*, that the matter in class 1 will be the only organic matter which permanganate of potash will remove. It will destroy this at once, whereas to destroy organic matter of the second class with permanganate of potash will require from fifteen minutes to an hour;

and to destroy matter of the third class will require from some hours to some days. Moreover, living matter has considerable resistance to the oxidizing power of permanganate of potash; microscopic animalcules will live for upward of an hour in water tinted with it, and living beings, visible to the naked eye, will live in a much stronger solution.

If a soldier, provided with permanganate of potash, after mixing a little with water waits only a few minutes before drinking it, he will certainly imbibe most of the organic matter of classes 2 and 3; whilst he would have to defer quenching his thirst for about half an hour before the matter of the second class would be destroyed, and for at least a day before matter of the third class would be attacked; and even then he would be by no means safe.

Practically, however, if the soldier used the permanganate at all, he would not be likely to do more than wait for a few minutes.

But the probability is so great as almost to amount to a certainty that the septic matter of the water would reside in the organic matter of classes 2 and 3.

The specific disease-producing particles are doubtless organized germinal matter, or cells, possessing physiological individuality, capable of preserving their activity for a certain time when out of the water in the form of slime, or even dust, able to adhere to material objects, and to be carried from one place to another on the clothing or in currents of air.

To remove these bodies from water, permanganate would be inoperative within the time in which it would be allowed to act. Filtration through charcoal would at first sight appear to be a satisfactory safeguard; but it is not sufficient, for many reasons.

In the first place, charcoal acts mechanically as a filter, and should therefore remove solid germs. But these cells are supposed to be so extremely small that it is doubtful whether they would be kept back by merely passing water rapidly through an ordinary filter; whilst, if they were kept back, they would accumulate only with their tremendous power for evil uninjured, on the upper side of the filter, ready at the first accident to act as the focus of a pestilence.

In the second place, a charcoal filter acts as oxidizing purifier for the water which passes through it. The oxygen condensed in its pores destroys organic matter somewhat as permanganate of potash does. To keep charcoal efficacious, however, as an oxidizer, it should be allowed to get dry nearly every day, and should be frequent-

ly cleaned. Even at its best it is not likely that it will oxidize organic matter more readily than will permanganate of potash, and hence matters of the second and third class—probably the most dangerous of all—are likely to pass through.

ACTION OF SULPHATE OF ALUMINA.

There is another purifying agent which has stood the test of long experience, and which possesses properties which are especially valuable in the present case. I allude to sulphate of alumina. When this salt is added to water containing organic matter of different classes, it passes by that which is so easily oxidized by permanganate of potash, but it attaches itself to organized animal matter—living germs—and converts them into an insoluble substance like leather. It is not quite certain whether this tanning operation destroys vitality; probably it does; but at all events, the precipitate is capable of being filtered with the greatest ease, whilst the addition of sulphate of alumina in no way interferes with the use of the permanganate of potash. If fine clay be used along with the sulphate of alumina, the precipitation takes place with great rapidity, and filtration need not be resorted to, but the clear water can be poured off the sediment in the course of a quarter of an hour.

DR. CROOKES'S MIXTURE FOR PURIFYING WATER.

Under the name of A B C compound, a mixture of sulphate of alumina, clay, and charcoal has been successfully used by the Native Guano Company for the purification of sewage. At their works, I have repeatedly seen the sewage of such places as London, Paris, Hastings, and Leeds converted in the course of a quarter of an hour from an offensive-looking, vile-smelling liquid, into water, bright, clear, inodorous, and tasteless, non-putrescible, and so free from injurious matter as to allow delicate fish to live and thrive in it.

With a little necessary modification, I consider that a mixture capable of acting thus on town sewage is the most suitable for the purification of water for drinking purposes on the Gold Coast.

I would suggest that the charcoal be omitted, and its place supplied by a permanganate. The ordinary potash salt will do, but if procurable in time, I have reasons for believing that permanganate of lime would answer the purpose better.

I have prepared a mixture of—

1 part of permanganate of lime,
10 parts sulphate of alumina,
30 parts fine clay,

and find that when I add this to London sewage in the proportion of 20 to 10,000, the purification is very satisfactory, and the settlement rapid. With foul ditch-water, a less quantity will do.

The mixture can be filtered, instantly yielding a bright filtrate, or it can be allowed to settle for a quarter of an hour, when the supernatant water can be poured off equally bright.

I am not prepared to say what the price of this mixture would be, but it would probably not be many pence per hundred gallons of water.

NEURALGIA.—CURE BY THE DEEP INJECTION OF CHLOROFORM.

IN a paper recently read before the Academy of Medicine, Philadelphia, Pa., Professor Roberts Bartholow, M.D., says:

It is true that the injection of a few drops of chloroform into the gums for the relief of toothache has been practiced by others, and by myself, with success; but hitherto, as far as I am aware, no one has used the deep injection of chloroform for the cure of *tic douloureux*. Indeed, the hypodermic injection of chloroform has been regarded as improper, owing to the violent local inflammation which follows its introduction to the subcutaneous areolar tissue.

The ill effects produced by the injection of chloroform into the areolar tissue are these: vaporization of the chloroform and consequent gaseous distention of the surrounding parts, painful swelling, inflammation, and the formation of an abscess. The pain experienced by the patient at the moment of injection is also considerable; and as the needle is withdrawn, the chloroform acts with energy on the wounded skin. These are very serious and almost insuperable objections to the hypodermic injection of this agent. The same objections do not hold against the deep injection of chloroform according to the method which I practice for the cure of *tic douloureux*. It is true, considerable pain is experienced and swelling arises, but the pain quickly subsides, and no inflammation ensues and no abscess is produced.

The needle is inserted under the upper lip, which is raised, and passed so deeply that its point shall rest near the infraorbital foramen. The chloroform is then slowly injected. When the needle is withdrawn, firm pressure from the cheek is made over the point of insertion of the needle, and is maintained for a time to insure the diffusion of the chloroform.

It is generally admitted that injection of the anodyne at

the site of pain is not necessary to the relief of neuralgia. The curative effect is supposed to be due to the impression made by the anodyne on the centre of consciousness. While this is undoubtedly true, there are many reasons for believing that the local influence of an anodyne on the end organs, the seat of a painful impression, is very serviceable, for pain of peripheral origin is made of two factors, an irritation of the sensory nerves, a realization of this irritation by the centres of conscious impressions. Furthermore, there are good reasons for believing that improvement in the condition of nerves, the seat of a painful sensation, reacts beneficially on the centre with which they are physiologically and pathologically connected, although the peripheral pain may be the reflection outwardly of a centric lesion.

It is a singular anatomical fact that the facial vein communicates with the pterygoid plexus and the cavernous sinus; hence an injection of chloroform into the part I suggested and practiced in this operation must reach the brain more directly than by any other route. The effect, hence, may be much more decided than when injection is practiced into remote parts.

Case 1.—Mr. M——, aged about fifty years, married, and by occupation a book-keeper; a tall, rather spare man, of nervo-sanguine temperament. His hair and beard are freely sprinkled with gray. Although pursuing a sedentary occupation, he has had considerable outdoor exercise, and led a rather active life. Being in good circumstances, his hygienic surroundings have been favorable. He has lived freely, and has always had a good appetite and vigorous digestion. He is accustomed to the daily use, in moderation, of whisky and tobacco.

About two years ago, Mr. M. began to suffer with pain in the infra-orbital branch of the fifth nerve. The attacks appeared with more or less frequency during the ensuing eighteen months, and gradually increased in severity.

When he presented himself to me for treatment, he was in the following state: he was emaciated, and his countenance was anxious and worn. Owing to the extreme suffering which mastication induced, he had great difficulty in getting a sufficient supply of food. Every motion of the lip, the gentlest washing of the face, a touch of the cheek, induced a paroxysm of pain of horrible severity. The pain was on the right side of the face, and was experienced in the infra-orbital nerve and its terminal branches. During the paroxysm, the muscles of the face were convulsed, the eye injected, and profuse lachrymation occurred. There was great tenderness to pressure over the infra-orbital

foramen, and a slight touch induced a paroxysm of pain. His teeth, although not very good, did not appear to be the seat of the irritation, for no pain was developed by pressure on or by striking them sharply. Raising of the upper lip always caused a severe paroxysm. In consequence of this, talking was painful, and the attempt to smile brought on an agony of suffering, so that he avoided seeing his friends. There were no evidences of intracranial disease except neuralgia, nor was there a history of specific infection.

I determined, as the patient was naturally most anxious to obtain relief, to inject chloroform. Charging the syringe with half a drachm of Squibb's chloroform, I passed the needle deeply under the lip, according to the method which I have already described, and injected the chloroform in the neighborhood of the foramen. Mr. M. experienced a very severe paroxysm of pain at the moment: this was succeeded by burning pain at the site of the injection, numbness of the lip, giddiness and sopor, and swelling of the cheek. In rising to walk, he staggered and had difficulty in maintaining the vertical position. He went immediately home and lay down, in consequence of the continued vertigo and drowsiness. The giddiness did not entirely disappear for twenty-four hours or more. The pain ceased and has not since returned, a period of more than three months having now elapsed. The patient did not again present himself until three weeks, being desirous to ascertain, beyond peradventure, that his relief was permanent, a fact which he could scarcely realize after the protracted and agonizing suffering which he had endured. A remarkable improvement had occurred in general condition in this time. He had gained largely in weight, and his countenance wore a cheerful expression, instead of the anxious and suffering appearance which it had before presented.

Case 2.—Mr. E. V. W——, farmer by occupation, aged about fifty-six, a man of medium height, compactly built, and of bilio-nervo-sanguinous temperament. He always had enjoyed good health, and led an active outdoor life. About five years ago, he began to experience decided pain in the infra-orbital division of the right fifth nerve. The paroxysms occurred at first at long intervals; within the past year they have rapidly increased, and during the last three months have been almost continuous. During this time, the lightest touch on the surface of cheek, a current of air, washing the face, raising the lower lip, and especially the mastication of food, have given rise to horrible paroxysms. Lately he has found it necessary to eat alone.

The frightful contortion of the muscles of the face, and the rolling of tears down his cheek during mastication, have excited so much apprehension in his family and friends as to render this isolation necessary.

As is usual in these cases of *tic douloureux*, the countenance of this patient expressed great suffering. He looked worn and anxious. When giving me his history, he had repeated paroxysms, during which the muscles on that side of the face became convulsed, the tears rolled down his cheeks, he ceased to speak, and his countenance wore an expression of great agony. He described the pains as of two kinds: a sensation of painful vibration in the face, eye, and forehead, and sudden darting pain, of intense severity, shooting up through the jaw to the eye and head. When I lifted up the lip to examine the mouth, he had an atrocious attack, and begged me to desist until the paroxysm ceased. There was no disease of the teeth. Besides the neuralgia, he had no symptom of cerebral disease. His functions were otherwise normal. The loss of flesh was plainly due to the difficulty experienced in taking in a sufficient supply of food.

I injected, in the way already described, thirty minims of chloroform. This brought on a severe paroxysm of pain, which continued for a few minutes, but was succeeded by a feeling of relief, numbness of the face and lip, some drowsiness, and swelling of the cheek. The relief to the pain lasted nearly twenty-four hours, when a light paroxysm ensued and the injection was repeated. In all, four injections were made in space of a week, but no pain was experienced after the second injection. At the expiration of two weeks, having had, meanwhile, no recurrence of his old malady, he called to say he was perfectly well. As he has not since presented himself, I have no doubt that he continues free from any return of the disease.

TREATMENT OF OBSTINATE CONSTIPATION.

DR. MACARIO, of Nice, in a communication to the *Lyon Médical*, observes that in treating constipation most practitioners confine themselves to enemata, laxatives, or more or less irritating purgatives, which in point of fact rather aggravate than cure the affection. He therefore wishes to make known what he says may be truly termed a "heroic" remedy, which he has employed during twelve years with such constant success that he can not but regard it as infallible.

Constipation, as every one knows, may be produced either by intestinal excitement with deficiency of secretion, (nervous constipation,) or in consequence of deficient con-

traction of the muscular coat of the intestine. Here it is produced by atony or intestinal indolence, which bad anti-hygienic habits have induced and keep up. The prolonged contact of the fæces with the rectum blunts the sensibility of the mucous and muscular tissues, and the synergical contraction of the upper portions of the large intestine either does not take place or does so in an insufficient degree, constipation being the result. In *nervous* constipation, the following pill should be given: Pure sulphate of iron, ten centigrammes; Socotrine aloes, five centigrammes; atropine, from one third to one half of a milligramme. In the *atonic* form, for atropine one centigramme of powder of nux vomica may be substituted. By the aid of these pills, regular stools may be procured, even in the subjects of obstinate constipation due to *ramollissement* of the brain and chronic myelitis with paraplegia. Dr. Macario gives from one to three pills immediately after dinner, the object being to produce one easy, natural, non-diarrheic evacuation. If more than this is effected, the dose is to be diminished, one or two pills sufficing in most cases. The use of these "antistyptic" pills ought not to be continued indefinitely, a longer interval being allowed to elapse between their administration in proportion as the constipation diminishes, it being of importance to allow the organs to resume their spontaneous action without any auxiliary. If the constipation returns, the pills can be again had recourse to. (95)

WEANED FROM HYPODERMICS.

A YOUNG lady who had been accustomed for a long time to the use of opium, applied to an eminent physician to make hypodermic injections of morphia. He commenced by making the injections as desired, of morphia and water; by degrees the quantity of morphia was lessened without her knowledge, until within a few days nothing but pure water was injected; after each injection, she would lapse into a quiet sleep, in the same manner that she had been accustomed to when under the actual use of morphia. This treatment was continued for several months, during which time tonics had been used, to strengthen the system and bring about a healthy condition after being so long a time under the influence of opium. When he considered it safe to do so, he told her plainly that she had not taken a particle of morphia for several months, and was entirely free from its influence; this statement, of course, was received with intense surprise, as well as unbounded joy. The lady is to-day entirely free from any desire for opium. (104)

NEW REMEDY FOR INTERMITTENT FEVER.

PICRATE of ammonia has attained notoriety as a substitute for quinine in cases of intermittent fever. It is most economically and conveniently fabricated by boiling carbolic with nitric acid, whereby nearly the theoretic quantity of picric acid is obtained. It may also be formed from salicin, indigo, benzoin, Botany Bay resin, silk, aloes, and ternitranisol.

Picric acid forms "salts" when combined with alkalies and bases called *picrates*. Most of these are very unstable and explosive when heated, because they contain so great a percentage of oxygen and nitrogen. It is therefore highly probable that the salt "picrate of ammonia," if serviceable in ague cases, acts either by *mutual decomposition or transmutation* of the miasmatic poison or virus, which latter may either be a chemical body or sporadic community, according to the distinctions made between the lower forms of animal and higher forms of vegetable life.

The chemical relations of picrate of ammonia have been investigated by the great masters Laurent, Liebig, Hatchett, Marchand, H. Rose, Schunck, and Cahours, but only Marchand has recorded properties that would imply its power to disorganize virulent matter. His investigations show that picric acid retains or neutralizes ammonia very feebly. If the morbid ferment which causes the nerves to recoil with such violence from its contact during the chilly stages of intermittent fever be an acid, and picrate of ammonia will surrender its alkali to neutralize it, one could understand the action of this remedy, because it is possible by its use to administer a quantity of the alkali which would excoriate the mucous membranes if taken as aqua ammonia; unless the same was so dilute as to impair its power or render it inactive through the affinity of ammonia for water. Besides, a large volume of water might attenuate the ferment and fermentable substances, and thereby increase the difficulty intended to be overcome. Of course this representation is theoretical. (96)

THE ACTION OF ANTISEPTIC SUBSTANCES UPON VIRUS.

M. DAVAINE has recently examined the following substances, which he classes in regard to their power as antiseptics in the subjoined order: Ammonia, silicate of soda, ordinary vinegar, and carbolic acid; then caustic potash, chloride of oxide of sodium (?), hydrochloric acid, permanganate of potash, chromic acid, sulphuric acid, iodine. The power of ammonia, of vinegar, and of carbolic acid being represented by 1-200, that of iodine would be by 1-12,000.

Iodine should therefore be considered as the best antiseptic to be employed in the treatment of maladies such as malignant pustule, boils, carbuncles, and the like, when, not having become localized under the form of a simple pustule, they have taken up a certain extension. Injections of 1-6000 of iodized water are recommended.

A NEW MODE OF TREATING DYSPEPSIA.

The Archives of Scientific and Practical Medicine, a new monthly edited by Dr. Brown-Séquard and published by the Lippincotts, contains, among other very interesting articles, one in which the editor describes a novel mode of treatment which he first tried with perfect success in a very bad case of dyspepsia in 1851, and which has since been tested, with more or less satisfactory results, in many cases of dyspepsia, chlorosis, and anæmia. The following is an extract from the account of the first case.

"After a few days, finding that he had not improved, I decided to try a radical change of his alimentation, as regards the quantity of food to be taken at a time. Instead of three meals a day, I made him take sixty or more. Every twelve or fifteen minutes, he took two or three mouthfuls of solid food, chiefly meat and bread. He drank a little less than a wine-glass of Bordeaux wine and water every thirty or forty minutes. On the very first day, this mode of alimentation was begun, his digestive troubles disappeared, and within a week he was so well that he returned to Paris. . . . He continued the same mode of alimentation for almost three weeks, and then gradually diminished the number of his homeopathic meals, and increased the amount taken at each of them, until in about eight or ten days he came to eat only three times a day, and a full meal at each time."

The following paragraphs will serve to give the reader a clearer idea of the treatment commended.

"The plan consists in giving but very little of solid or fluid food or any kind of drink at a time, and giving these things at regular intervals of from ten to twenty or thirty minutes. All sorts of food may be taken in that way, but during the short period when such a trial is made, it is obvious that the fancies of the patients are to be laid aside, and that nourishing food, such as roasted or broiled meat, and epecially beef, mutton, eggs, well-baked bread, and milk, with butter and cheese, and a very moderate quantity of vegetables and fruit, ought to constitute the dietary of the patients we try to relieve. This plan should be pursued two or three weeks, after which the patient should

gradually return to the ordinary system of eating three times a day.

"The most varied diet as regards the kind of food can be followed under this plan as well as when one has only two or three meals a day. The only absolutely essential points are that the amount of food taken every 10, 15, 20, or 30 minutes be very small, (from one to four mouthfuls,) and that the quantity of solid food in a day be from 32 to 42 ounces, or a little less when, instead of water, the patient drinks beef-tea or milk."

NEW REMEDIES FOR CHOLERA.

FRENCH physicians, as a rule, hold to the fungoid theory of cholera, and one of their number has been experimenting with the carbolate of ammonia in cases of cholera; so far, we learn, with encouraging success. One physician (Dr. Déclat) looks upon carbolic acid as a prophylactic, to be used in the ordinary way of diet during epidemics. It is taken in the form of syrup. When a patient is attacked with cholera, the syrup should be administered, and a dilute solution of the acid injected. In severe cases, the doctor employs a syrup of carbolate of ammonia, with subcutaneous injections of the same; and he is so confident as to the efficacy of his remedy that, in cases where dissolution is impending, he injects a solution of the carbolate of ammonia directly into the veins.

THE EFFECTIVE PRINCIPLES OF COFFEE.

ALTHOUGH it is known that coffee and tea contain the alkaloids caffeine and theine, it is not known what percentage of loss of the caffeine occurs by roasting the coffee, or how much of it and other substances are, by that process, extracted; nor is it known whether, aside from the principle mentioned, there are no other effective ingredients in coffee. With a view of settling these questions, Mr. Aubert has carried out some experiments, from which we condense the following: When the coffee was roasted until it assumed a bright-brown color, no caffeine was discovered in the collected vapor; but by roasting it until it became almost black and assumed a fatty lustre, the alkaloid could readily be found. The loss occurring in this wise amounted to 0.927 per cent. On the other hand, the extract from strongly roasted beans is poorer in caffeine than that produced from the less roasted. With regard to the physiological effects of caffeine upon animals, it produces, in sufficiently large doses, increased excitability and even tetanus, and thus acts like strychnia. And another similarity to this poison consists in that the action

ceases as soon as respiration is sustained artificially, five minutes' respiration being sufficient to make even large doses inoperative. With regard to the question whether the effects of the extract of coffee are dependent upon its amount of caffeine, M. Aubert has discovered that an infusion of coffee, from which this principle had been separated, produced different but not less characteristic effects upon animals. However, it seems to be not yet decided to what ingredient coffee owes the invigorating effect to which its extensive use is due.

DISINFECTION OF AIR OF SICK-ROOMS.

THE three best agents for accomplishing the disinfection of air after small-pox or other contagious diseases, are sulphurous acid, iodine, and carbolic acid. The best method of employing sulphurous acid is to scatter a little flowers of sulphur upon a heated shovel and carry it about in the room or rooms which are to be disinfected.

Iodine may be used by simply placing a little in an open glass or earthen vessel, and it vaporizes readily at the ordinary temperature of a house. Carbolic acid may be employed by sprinkling a weak solution of it on the floor of the room, cloths wetted in such solution may be hung about the rooms. A simple apparatus for using this acid is to have a broad band of cotton passing over two wooden rollers over a dish filled with a solution of the acid. As the upper half of the band dries, give the rollers a turn, and the lower half of the band, wet with the solution, takes its place uppermost.

ZINC BANDAGES IN SURGERY.

AN interesting and important experiment in surgery was recently performed at the Park Hospital, New-York, in the presence of a number of distinguished surgeons, by Dr. Fluhrer, inventor of a new bandage for fractured limbs. The contrivance consists of a number of perforated zinc strips, which, when once arranged, form an absolutely inflexible bandage, not to be disarranged by any violence or uneasiness of the patient. As soon as these cover the point of fracture, the limb is firmly set and the natural outline restored. In one of the wards of the Park Hospital was Francis Lefry, a truckman, who had a compound fracture of both thighs. No parallel case of dual fracture, it is said, is on medical record; and, as the most unpromising, the doctor selected it for a practical test. After ether had been given to the patient, Dr. Fluhrer bent over the sole of each foot a broad zinc strip in the form of a loop, the extremities of which were securely wrapped with cloth

bandages previously steeped in plaster of Paris, which were prevented from slipping by the tooth-like projections of the reverse side of the punctured zinc. The terrible fracture of both thighs, when the limbs were stripped for this purpose, could be plainly perceived. To the loops were fastened stout cords, which passed over the grooves of pulleys affixed to the adjacent wall, and were drawn taut by Warden Brennan. Dr. Fluhrer next mummified the limbs with a multiplicity of bandages, over which he laid his zinc strips, and covered them with a second stratum of bandage. Immediately the lumpiness about the region of injury disappeared, and the doctor expected that, in six weeks, this bandage would be removed, and in two more the patient would have the use of his legs.

THE SANITARY CHEMISTRY OF WATER.

DR. CHANDLER, of the Health Board, New-York, states that the organic matter which is dangerous in water is sewage, and many diseases, especially cases of typhoid fever, have been developed by the presence of these impurities in water. Actual experiment shows that water which remains over night in lead pipes in New-York contains 1-10 of a grain of lead to the gallon. It seems to be well established now that rivers possess the power of self-purification, and the drainage of a great city can be received within an ordinary river without destruction of its wholesomeness. The Croton water brought to this city every day contains 22½ tons of mineral matter. To poison the Croton water for one day, it would require 3½ tuns of strychnine, and there is not, probably, a ton of strychnine in the world. It would take 114 tons of arsenic to serve the same purpose. So it may be seen that threats of poisoning the Croton supply during the war were ridiculous.

A SIMPLE METHOD OF IMPROVING THE HEALTH OF CITIES.

DR. ALFRED CARPENTER, of London, strongly recommends the connection of all house-drains with one of the chimneys, or with a special ventilating pipe leading to the roof of the dwelling. By this simple arrangement a circulation of air through the sewers is obtained, and the foul gases, instead of entering the house to produce typhoid and other diseases, would be oxygenized, rendered innocuous and dissipated.

In New-York and other cities, there are thousands of unhealthy dwellings, made so by the back pressure of air from the sewer-pipes, which would be instantly cured by the use of a few feet of pipe to connect the house-drains

and water-closet pipes with the chimneys. We believe that the passage of a law requiring the insertion of such pipes would be an excellent sanitary provision. We compel the owners of tenement-houses to place fire-escape ladders upon the outsides of their buildings, as a means of saving life in case of conflagration. But a far greater number of lives might be saved if owners were compelled to put in vent-pipes, as above indicated. Noxious air from the sewers is one of the main causes of disease and death in all large towns.

WHEN TO USE TEA.

DR. ADAM SMITH, in a paper read before the London Society of Arts, recommends the use of tea in the following cases: After a full meal, when the system is oppressed; for the corpulent and the old; for hot climates, and especially for those who, living there, eat freely, or drink milk or alcohol; in cases of suspended animation; for soldiers who, in time of peace, take too much food in relation to the waste proceeding in the body; for soldiers and others marching in hot climates, for then, by promoting evaporation and cooling the body, it obviates, in a degree, the effects of too much food, as of too great heat.

NEW METHOD FOR BEEF-TEA.

DR. H. C. WOOD says, Take a thin rump-steak of beef, lay it upon a board, and with a case-knife scrape it. In this way, a red pulp will be obtained, which contains pretty much every thing in the steak, except the fibrous tissue.

Mix this red pulp thoroughly with three times its bulk of cold water, stirring until the pulp is completely diffused. Put the whole upon a moderate fire, and allow it to come slowly to a boil, stirring all the time to prevent the "caking" of the pulp. In using this, do not allow the patient to strain it, but stir the settlings thoroughly into the fluid. One to three fluid ounces of this may be given at a time.

AFRICAN WATER-FILTER.

PERSONS about to travel over great deserts or along a sandy seashore, might take a lesson from the native African as to the best method of obtaining a drink in such places. The operation is described by Livingstone as follows:

"The women tie a bunch of grass to one end of a reed about two feet long, and insert it in a hole dug as deep as the arm will reach, then ram down the wet sand firmly around it. Applying the mouth to the free end of the reed, they form a vacuum in the grass beneath, in which the water collects and in a short time it rises to the mouth."

A NEW DIETETIC.—Dr. Goodman, writing to the *British Medical Journal*, says that artificial fibrin is an admirable dietetic substance, being unparalleled for lightness and digestibility, and a great delicacy besides. It is obtained by exposing albuminous material to the action of cold water for a time, the hen's egg, from its great abundance, being the most suitable source of the albumen. When the contents of an egg are immersed in cold water for twelve hours or thereabouts, they undergo a chemico-molecular change, becoming solid and insoluble; a change indicated by the opaque and snowy whiteness of the white. The action of heat to the boiling-point is now brought into the process, and the fibrin is then ready for use. In cases of deficient nutrition and rejection of food, Dr. Goodman says this artificial fibrin is of the greatest service, as the weakest stomach is able to retain it, and its use appears to promote the appetite for food.

NEUTRALIZING THE TASTE OF COD-LIVER OIL.—C. D. Bradley, of Taunton, Mass., states that this may be accomplished by mixing with each table-spoonful of oil, twelve drops of the following compound: Two ounces of essence of lemon, one of sulphuric ether, and a half-ounce each of the essential oils of caraway, peppermint, and cloves.

EMBALMING THE DEAD.—In the Vienna Exposition, there were several specimens of the embalming of parts of the human body. Those exhibited by Dr. Martini, of Naples, were particularly to be noted. One of these was a large round table made of muscles, sinews, etc., of a dark-brown color, with a handsome polish. Among his other exploits he petrified Thalberg, the deceased pianist, and the widow is said to keep the corpse in her drawing-room. He also embalmed Mazzini, and so well that some of the more economical admirers of that statesman urged that the body should be set up in Rome as a statue, and thus save expense.

A NOVEL BATH.—One of the therapeutic novelties in London, recently introduced from the continent, consists in the erection of establishments for administering hot sand-baths as a remedy for rheumatism, recent cases of nervous disorders, affection of the kidneys, and all cases where heat is wanted as the chief therapeutic agent. The advantages of this treatment are, that it does not suppress respiration like the hot-water bath, but rather increases it, and does not interfere with the respiration like the steam-bath or Turkish bath. The body can endure its influence for a much longer time, and a much higher temperature can be applied.

ON THE USE OF ELECTRICITY IN SURGERY AND MEDICINE.

AT a recent meeting of the Medical and Surgical Society, of Baltimore, Md., Dr. John J. Caldwell read the following paper, showing the latest aspects and successes of electricity as a remedial agent:

As the result of our own practice and experience, we may state that the successful application of electricity is, in no case, more strikingly manifest than in the removal of morbid growths by the electro-cautery, especially those of a soft and bleeding character, found in the rectum, vagina, and other passages, and, indeed, in any part of the body where the use of the knife is impracticable.

This force, when applied to electro-puncture in the treatment of aneurisms, has not been so successful in our experience, though Ciniselli, in the *Medical Press and Circular*, of London, reports many cases of success by this mode, and gives full and particular instructions as to the use of the needles and the necessary apparatus. The same force modified, in the treatment of ulcers, is termed electrolysis; the mode of application is, to moisten porous paper or linen, cloth, etc., with a solution of the mineral or earthy styptic salts, applying it immediately to the ulcer; then placing the positive pole, in the shape of a zinc electrode, to this covering, passing the negative pole gently around the ulcer, we have an electro-chemical action brought about which deposits the mineral particles upon the morbid surfaces.

The exhibition of this current should be maintained at each sitting for ten or fifteen minutes, and should be made daily. Indolent ulcers, of long standing, have yielded kindly to this process after the failure of almost every other means. A singular advantage of this mode is its lessening of the sensibility of the diseased tissue.

In a late and able paper, my esteemed friend Alexander Murray, M.D., L.R.C.S., Edin., etc., also a member of the Electro-Therapeutical Society of New-York, who has had large experience in this process, says: "I prefer, however, to use the dilute mineral acids, on account of their stringent and chemical properties. I cover the bottom of the ulcer with a little lint, cotton-wool, or granulated sponge; then wet the sponge with whatever agent the nature of the disease may require, and apply the metal disc directly to the saturated material; while I keep one electrode stationary for a few moments in the cluer, I work the second conductor slowly around the diseased part; thus I have the nascent chlorine, oxygen, etc., directly eliminated and applied to the parts."

His paper is replete with cases and results, and is well worthy the observation of the surgeon.

Further on, the Doctor says, in reference to indolent ulcers, that the flabby, livid-colored granulations which are usually found in them, after one or two applications of galvanism, are soon changed to a healthy flesh or rose-color.

He denominates this method of treatment Galvano-ozonization.

Dr. Murray eulogizes this mode of treatment, and remarks that he finds no reference whatever regarding its use, or mode of application, in any work on electro-therapeutics which he has consulted; whereas, in an article entitled "Electro-chemical Action on Cell-tissues," read before the Electro-Therapeutical Society of New-York, and published in the New-York *Medical Journal*, we introduced and particularly dwelt upon this mode of treatment in malignant growths and ulcers, and termed it electrolysis.

We presented to the society a phial of tissue electrolyzed into fluid extract, (beef cell-tissue,) at the time of reading the afore-named paper, the specimen still retaining its original freshness and condition, probably attributable to its being charged with free chlorine. This mode of treatment we regard with great consideration, because we think it clearly points to a new era in the treatment of morbid growth.

Through this mode, we have been successful in dissipating scirrhus in its early stages, and other tumors of various characters, ulcers, etc.

Galvanism, in the treatment of parasitic skin-diseases, thus far, in our hands, has been quite successful. By its electrolytic force, no doubt, the liquids are coagulated, and the animalculæ disintegrated.

We have also employed it in the treatment of eczema with some good results, but not with that brilliant success claimed by George M. Beard, M.D., of New-York. This arduous and original worker in the fields of electro-therapeutics claims to have cured the afore-mentioned and several other skin-troubles by central galvanization alone, without making any application to the diseased surface, and cites many cases, both in private and hospital practice, to verify his statement.

Galvanism, in the treatment of neuralgia of various kinds, is one of our most valuable adjuncts. Of course, we must bear in view the origin or cause of the complaint, namely, if malarious, use quinine; if specific, iodine, iodoform, etc.; if neurasthenic, cod-liver oil and the phos-

phates; if mechanical, the surgeon's interference; but in most of these cases we have one or two conditions of the spinal cord, hyperæmia or anæmia.

In hyperæmic neuralgia, hypodermic injections of ergotine and galvanism; in anæmic neuralgia, strychnine and faradaism. In both instances, we have nausea and dull pain in the stomach, as the remote demonstrations, as well as pain of the joints, face, and other neuralgic regions.

The morbid conditions wherein electro-therapeutical applications are indicated may be briefly summedup, namely, in their efficacy in restoring normal action in partial or general paralysis, or wherever there is great atrophy or an inert muscular action, dependent upon deficient nervous tone or deranged action in the nervous centres; in the subjugation of the violent pain of articular rheumatism; in certain atonic or debilitated conditions of the system, owing to impaired nutrition; in the removal of malignant tumors where surgical interference is entirely out of the question, and especially in the extirpation of soft, morbid growths, etc.; and the effects of electrolysis and galvanism have been successfully demonstrated upon anatomical secretions, excretions, and morbid cell-developments. In applying electricity to tumors, we use electrodes with sponge-tips, saturated with a strong solution of chloride of sodium. We always commence from the border of the tumor and gradually approach the more solid particles; as a result, suppuration and absorption set in and destroy the growth.

In this connection, we beg leave to refer to a case which came under our own treatment.

Dr. G., a prominent Catholic clergyman, of Brooklyn, N. Y., who suffered from malignant tumor, involving the right side of the face, neck, trachea, and other vital organs, to such an extent as to be unamenable to surgical treatment. He had consulted prominent members of the profession without encouragement or success. The growth was rapid and pointed to an early dissolution by suffocation, presenting all the characteristics of scirrhus. In June, 1871, he called at our office to consult us concerning his trouble, whereupon we informed him of its serious and threatening nature, and that, in our opinion, little encouragement could be given, save that which might be afforded by the judicious use of electricity.

Our treatment in this case was daily application of the galvanic current, from a sixteen-cell battery, (of G. F. Manf. Co.) This treatment was continued from June 5th to July 7th, twenty-four applications in all, with great suc-

cess, the tumor having entirely disappeared, relieving him of all its distressing features.

What might be termed the surgical advantages of the electro-cautery will be illustrated by the following case which came under our observation :

Mrs. W. F., of Kentucky, had a growth which originated upon her left breast, and which increased in size so rapidly as to produce great constitutional disturbances, by deposits in other parts. Even in her case, we were able to afford great relief temporarily ; for cropping out from the main growth was a bleeding fungoid, which was so large as to involve the axilla and impinge upon the free movement of the arm ; this we removed while the patient was etherized, by the electro-cautery loop ; she rallied kindly and did not lose enough blood to stain the clothes about her.

By the electrolytic power we have removed successfully three cases of scirrhus during the early stages of development ; as yet there has been no return of the disease.

It would be out of place, in a paper of this character, to enumerate all the heterogeneous maladies which electricity, either in one or the other of its three currents, namely, electro-tonic, electrolysis, electro-cautery, has proved serviceable in. The electro-tonic will be found highly useful in modifying irritability of nerves of special sense, whilst galvanism (electrolysis) has been found curative in partial paralysis of the vaso-motor nerves, in troubles of the pneumo-gastric nerves, such as asthma, dyspepsia, etc., in primary arterial spasms, apoplectic paralysis, in the cases of muscular progressive atrophy, in early stages of progressive locomotor-ataxy, and in neuralgic affection of cerebro-spinal nerves. It was for the removal of dyspnœa that led Dr. Phillips, of England, to try galvanism as a remedy in asthma. By transmitting the current from the nape of the neck to the pit of the stomach, he gave decided relief in every one of twenty-two cases.

Claude Bernard believes that in the human subject diabetes mellitus is due to an over-activity of the nerves which stimulate the function of the liver, and considers it possible that, if it were in our power to galvanize the sympathetic nerve, this would be the best possible mode of treating diabetes symptomatically, the function of this nerve being weakened by the undue activity of its antagonists.

Finally, we will mention two cases of progressive locomotor-ataxy in its first stage, as the result of sexual excesses and exposure to cold, successfully treated by the faradic current, with hypodermic injections of strychnia

along the cord; duration of treatment about three months, with an application of the current every other day, of fifteen minutes' *séance* each; injections two or three times a week. In the first case, the young man had lately married, and to the ardor of youth we must ascribe his trouble. In the second, a young English gentleman endured great exposure to cold on a gunning frolic in Virginia, the thermometer ranging about zero, being much below his native climate, (England.) In both cases, the symptoms were much alike, namely, a loss of power of coördinating movements; so that they had difficulty in walking, lost their balance frequently, had an uncertain and tottering gait, much like a drunken man, could not walk across the floor with their eyes closed without danger of falling head-foremost, suffered from rheumatic pains, sharp pains in limited spots, say thighs, knees, and shin-bones; bottom of the feet felt as though covered with thick plasters, with occasional prickings, as with pins and needles; when walking, must watch their legs to prevent staggering or falling; legs thrown forward spasmodically.

IS PHOSPHORUS THOUGHT?

THERE appears still to be much difference of opinion among chemists about the changes which occur in the secretion of the kidneys after waste of nerve-tissue. For example, Dr. L. Hodges Wood, as the result of his observations published in 1869, denied the correctness of the generally received statement that the amount of phosphates in the urine is increased by fatiguing mental exercise. He found that, while the alkaline phosphates were slightly increased, the earthy phosphates were notably diminished after mental work, and that, when the mind was not much employed, the excretion of earthy phosphates was increased instead of diminished. He accounts for this on the hypothesis that, when the brain was worked, it withdrew more phosphorus from the circulating fluid. (112)

SILICATE OF SODA FOR WOUNDS.

M. CHAMPOUILLON recommends the use of the silicate of soda in the treatment of all superficial wounds and abrasions of surface. It acts, he says, not only as an antiseptic, but also protects the surface from the action of the air and of any germs it may contain. He also states that excellent results have followed its use as an injection in case of ulceration or purulent discharge from all mucous membranes. The strength of the solution is to be varied according as it is applied to the skin or to cavities lined with mucous membranes.

ORIGIN OF INDICAN IN URINE.

By Jaffé.—The author has made the interesting observation that after the sub-cutaneous injection of indol, (prepared by Baeyer's method,) very considerable quantities of indican constantly appear in the urine. The elimination of the latter body begins a few hours after injection, and generally ceases within twenty-four hours. Kühne has shown that indol is one of the products of the pancreatic digestion, so that Jaffé's previous conjecture that the indican of urine is partially, at least, derived from this source, appears to be verified. The indol of the intestinal canal is, for the most part, ejected with the fæces, imparting thereto its peculiar odor; a small portion is absorbed and reappears in the form of a conjugated compound, indican, in the urine. (32)

THE PHYSIOLOGICAL ACTION OF LIGHT.

The arrangements by which the mind is brought into relation with the outer world are—(1) a terminal organ, such as the retina, or the intricate structures of the internal ear, or the touch corpuscles of Wagner, for the reception of impressions from without; (2) a nerve, endowed with a special sensibility peculiar to the sense for the conveyance of influences from the terminal organ to the brain; (3) a sensorium or brain in which, on receiving these influences, changes occur which give rise to the phenomena of consciousness.

The nature of the specific change produced on the terminal organs by the action of external stimuli has not hitherto been experimentally examined. Let us take the case of the eye. Numerous hypotheses have been advanced. The action of light on the retina has been conjectured to be a mere communication of vibrations, an intermittent motion of portions of the optic nerve, an electrical effect, a heating effect, or a photographic effect like that produced by light on a sensitive surface; but up to this time there has been no experimental evidence in support of either of these views.

The result of investigations made by Mr. Dewar and Dr. McKendrick, of Edinburgh, communicated to the Royal Society of Edinburgh, has been to show that the specific effect of light on the retina and optic nerve is a change in the electromotive force of these organs. They have been able to demonstrate this by the use of the well-known arrangement of Du Bois-Raymond for collecting electric currents from animal structures.

From each of the troughs a wire passes to a key so as to enable the experimenter to stop the current at pleasure,

and thence the current passes to the galvanometer. They then lay the eye on a glass support between the cushions, and carefully adjust the points so that the one touches the cornea and the other the transverse section of the optic nerve, or the one may touch the surface of the nerve and the other its transverse section. When the optic nerve of the eye to be operated upon and the cornea are brought into connection with the galvanometer, and light is passed through the eye, there is at first an increase, then a diminution, and on the removal of light, there is another increase of the electro-motive force.

The amount of change in the electro-motive force by the action of light is about 3 per cent of the total. There has been no difficulty in demonstrating the effect in the eyes of the following animals, after removal from the body: reptiles, snakes; amphibia, frog, toad, newt; fishes, gold-fish, stickleback, rockling; crustacea, crab, swimming crab, spider crab, lobster, hermit crab. The greatest effect was observed in the case of the lobster, in the eye of which Messrs. Dewar and McKendrick found a modification in the electro-motive force by the action of light to the extent of about ten per cent. With the eyes of birds and mammals, they had great difficulty. It is well known that, in these animals, the great source of nervous power is abundant supply of healthy blood. Without this, nervous action is soon arrested. This law, of course, holds good for the retina and optic nerve. When, therefore, they removed the eyeball, with nerve attached, from the orbit of a cat or rabbit recently killed, and placed it in connection with the clay points, they found a large deflection of the galvanometer which quickly diminished, but all sensitiveness to light disappeared within one or two minutes after the eye had been removed from the animal.

This fact of itself shows that what has been observed is a change depending on the vital sensibility of the part. It was therefore necessary to perform the experiment on the living animal under chloroform. By so fixing the head that it could not move, and by removing the outer wall of the orbit so as to permit the clay points to be applied to the cornea and nerve, the same results have been obtained in the case of the cat, rabbit, pigeon, and owl.

Without going into minute detail, which the space allowed for this short article will not admit of, the results of this inquiry have been as follows:

1. That the specific effect of light on the eye is to change the electro-motive force of the retina and optic nerve.

2. That this last applies to both the simple and to the compound eye.

3. That the change is not at all proportional to the amount of light in lights of different intensities, but to the logarithm of the quotient, thus agreeing with the psycho-physical law of Fechner.

4. That those rays, such as the yellow, which appear to our consciousness to be the most luminous, affect the electro-motive force most, and that those, such as the violet, which are least luminous, affect it least.

5. That this change is essentially dependent on the retina, because, if this structure is removed while the other structure of the eye lives, though there is still an electro-motive force, there is no sensitiveness to light.

6. That this change may be followed into the optic lobes.

7. That the so-called psycho-physical law of Fechner does not depend on consciousness or perception in the brain, but is really dependent on the anatomical structure and physiological properties of the terminal organ itself, inasmuch as the same results as to the effect of light are obtained by the action of the retina and nerve without the presence of brain.

The method of investigation pursued by Messrs. McKendrick and Dewar is applicable to the other senses, and opens up a new field of physiological research. The specific action of sound, of the contact of substances with the terminal organs of taste and of smell, may all be examined in the same manner; and we are in hopes of soon seeing results from such investigations. (47)

ARTIFICIAL FIBRINE AS A DIET.

DR. JOHN GOODMAN says: "As a member of the British Medical Association, and in the common interests of humanity, I have much pleasure in calling attention to my discovery of this new dietetic substance. So far as I have employed it, it promises fair to be invaluable in medical practice, especially in cases of feeble alimentation and deficient nutrition, and second to none in those cases where rejection of food forms a prominent feature, or where the appetite and digestive powers are reduced to a minimum. As fibrinous material, it is of course highly nutritious, and eminently adapted to all cases where there is a deficiency of fibrine in the blood. It is, perhaps, unparalleled in its qualities of lightness and digestibility, and is, moreover, a great delicacy. In many urgent cases of rejection of food, etc., it not only remains where an egg otherwise cooked would not be tolerated, but its presence in the stomach has been found to create a feeling of want

rather than of superfluity, and to promote rather than decrease the appetite for food.

"The production of this substance is within the reach of every sick-room, and is effected with great facility. It is formed by exposing albuminous material to the operation or influence of cold water, for a given period, and on account of its great plenteousness we employ the ordinary hen's egg for its production. When the shell is broken and removed, and its contents are immersed in cold water for twelve hours or so, they are found to undergo a chemico-molecular change, and to become solid and insoluble. This change is indicated by the assumption, by the transparent white of the egg, of an opaque and snowy white appearance, which far surpasses that of an ordinary boiled egg. The product and the fluid in which it is immersed must now be submitted to the action of heat to the boiling point, when the fibrine will be ready for use."

We will add that on trial we find that, for table use, the eggs thus prepared are most excellent, and this method of preparation will no doubt soon come into general use. Instead of boiling in the water in which the eggs are originally placed, they may be removed therefrom after standing twelve hours and put at once into boiling water.

(79)

THE MENTAL ATMOSPHERE.

THE probability of the existence of a mental atmosphere is a question which has attracted considerable attention, and which in time will probably throw much light on the nature and action of mental phenomena.

We all know that any mental action results directly in molecular change; it is performed at the expense of certain constituents of the nervous system, notably phosphorus. It transmits a definite wave of motion, at a rate which has been accurately measured, to the distal extremity of the appropriate nerves; how much farther, we do not know. Many instances also illustrate the high quality of mental force. It can produce the most important changes, even ulceration or gangrene, in the remotest parts of the body, and aid with equal power in processes of restoration and growth.

That the superficies of the body does not bound its activity numerous facts demonstrate. To pass by the less remarkable and more familiar ones, there is the most positive evidence that those gifted with "second sight," as it was once called, do possess an undefined power of knowledge which transcends the senses. The presence of danger is often felt before any warning reaches us through

the senses. Men who live lives of peril know this perfectly well, and are the last to underrate such feeling.

Another form of this external mental power is that by which a strong emotion or a fixed attention on an object will excite a similar emotion or the picture of a similar object in another person without any communication. A certain natural analogy and a special training is required to bring this about. The French "magician" Houdin has established such a mental relation with his son, so that the latter, though blindfold, would at once name an object shown to his father, though the width of a large room intervened.

Undoubtedly as emotional influences are clearly epidemic and contagious, there is nothing incredible in the belief that ideas should also possess equal powers beyond the superficies of the body or the limits of expression.

(112)

MENTAL LABOR AND HEALTH.

"INTELLECTUAL activity," says the *Lancet*, "is a preserver rather than a destroyer of nervous health: but this holds true only when the conditions of ordinary hygiene are not outrageously violated." If, coupled with the intellectual strain, we have harassing anxiety, sleeplessness will result, and this is fatal. But suppose there is no such anxiety, but merely ardor for work, then a man might easily transgress the plainest laws of health. The minimum of the sleep required by the adult male in twenty-four hours is six hours, and by the adult female, seven. As for night-work, the *Lancet* does not think it injurious *per se*. The light should be very white, powerful, and steady, otherwise there will be brain irritation. The intellectual worker must obey implicitly the reversed scriptural law: "If a man will not eat, neither shall he work." He must take abundant nutriment, at proper times, together with a "moderate amount of stimulants." But any excess of alcohol or tobacco will produce insomnia: indeed, hundreds of cases where insomnia is charged to the account of "overwork" are best explained by excess in stimulation.

HUDSON ON LIABILITY TO DISEASE.

DR. ALFRED HUDSON, in a recent lecture reported in the London *Medical Record*, pointed out various causes that predispose the body to disease, rendering it liable to suffer from contagion; and after referring to the various theories with regard to contagion, he stated that he believed typhus fever had its origin principally from overcrowding, and was not so much the result of contagion.

The importance of the study of predisposing causes in a sanitary point of view rested in a great degree upon

three considerations: first, that liability to zymotic disease exists in different persons in different degrees; secondly, that its amount varies in the same person at various times and under various conditions; and, thirdly, that many of these conditions are preventable. He remarked that fatigue was one of the most frequent of the causes that predispose to disease, and that this was shown in the case of soldiers who suffered so much after long marches, often exposed to the worst influences of the weather. Dr. Hudson concluded an able and exhaustive lecture by stating that the following were some of the conclusions to be arrived at from the facts that had been adduced: 1. That liability to zymotic disease may be considered inherent in our constitution—a law of our nature. 2. That this varies in degree in different individuals at different times and under different circumstances. 3. That these circumstances are partly external, or extrinsic, and partly intrinsic conditions. 4. That both are partly preventable and partly non-preventable. 5. That, *cæteris paribus*, liability is least in those in whom healthy blood, healthy tissues, and healthy excretion coexist, constituting perfect nutrition. 6. That it is greatest in those whose blood contains the greatest amount of the products of waste of the tissues and of matters in a state of decomposition introduced into the circulation from without.

COLOR-BLINDNESS.

DR. FAVRE communicated to the French Association the results of his observations on Daltonism, or color-blindness, in railroad employees. As physician to the Paris and Lyons Railway Company, he has enjoyed special facilities in studying this question, which has so important a bearing on the safety of the traveling public. In 1196 men examined between 1864 and 1868, he found 13 cases of insensibility to red rays, and 1 to green. Seven hundred and twenty-eight men were examined in 1872–73, who presented 42 more or less clear cases of Daltonism. Dr. Favre insists on the necessity of frequently examining the engineers, switchmen, and other employees who are charged with displaying and observing signals.

IS ROWING HEALTHY?

DR. J. E. MORGAN has recently published, in England, a work entitled, *University Oars*, in which he considers the hygienic effects of the rowing contests which for the past forty years have been carried on between the great English colleges. The author is not only an eminent and scientific surgeon, but an oarsman himself of no small repute, so that his qualifications are in every respect ade-

quate to the task which he undertakes. The plan pursued in compiling the facts is worthy of notice, on account of the immense labor it entailed in seeking out the men who have rowed in these inter-university contests wherever they might be, and obtaining their verbal testimony if living, or that of their friends if dead, as to the results, entailed by work at the oar, upon their constitutions and frames: 294 men had thus to be discovered, and Dr. Morgan states that 245 were found to be living. The results elicited by his inquiries he tabulates as follows: Benefited by rowing, 115; uninjured, 162; injured, 17. The benefits considered are increase of strength and stamina, of energy to undertake, and of power to undergo physical exertion; increase of fortitude to encounter and to submit to trials and privations and disappointments. Those termed uninjured are men who state they have "never felt any inconvenience from rowing," while the injured all assert, with more or less distinctness, that their exertions have proved harmful. It is concluded, on an examination of the latter class and the nature of the evil results, that the proportion is very small when the number of men is taken into consideration, and that no other pastime, hunting, ball, or cricket, would, if closely scrutinized, yield so small a percentage of harm.

VINEGAR AS A PROTECTIVE AGAINST SMALL-POX.

DR. MAX HELLER (*Med. and Surg. Reporter*) writes: Adults and half-grown persons, who were for a considerable time in the room with a patient during the development of small-pox, consequently breathing the same air, and even assisting him or her, by the *use of vinegar* either escaped altogether, or, if they were attacked from the tenth to the thirteenth day with fever, lassitude, pain in the limbs, etc., in consequence of which they were confined to bed, these symptoms lasted only from two to three days, after which they felt well again, with the exception of some fatigue, and from one to four small pustules the size of a pin-head appeared on the face or upon the arms. Moreover, no injurious effect upon the general health was experienced, not even in children, to whom it was given by the tea-spoonful, in consequence of the over-anxiety, without orders.

All persons who came in direct or indirect contact with the small-pox patient were subjected to the vinegar treatment, and with much benefit. Healthy adults were ordered two table-spoonfuls of common vinegar, either with or without water, to be taken one hour after breakfast and

toward evening for fourteen days; for half-grown or particularly delicate persons, three fourths of a table-spoonful once or twice daily will suffice. They should avoid the sick-room as much as possible, enjoy plenty of fresh air, and guard against cold; the sick-chamber is to be fumigated with vinegar vapors twice daily.

He also recommends to persons who communicate much with the public, as people in large cities, to take now and then a table-spoonful of vinegar for a week.

TYPHOID FEVER.

IN a recent lecture on typhoid fever at Guy's Hospital, Sir William Gull remarked that, two hundred and fifty years ago, one of the kings of England died of ague, but now, by improved agriculture and drainage, the disease had become rare, and certainly very few die of it. Typhoid fever, he asserts, is as preventable as ague, and two hundred and fifty years hence, deaths from it will be as rare. The disease is caused by a virus of nature, which may get into the healthy body, increase in it, and destroy it. It is an accidental condition, and not one of the ordinary processes of nature. The origin of the disease is somehow or other connected with drainage; it has therefore been called the filth-fever, and to get rid of the filth is to get rid of the fever. This was illustrated in the case of the Milbank prison, where typhoid and dysentery were once thoroughly established, but where both almost wholly disappeared when the water-supply was changed and efficient drainage provided. In his closing remarks on the treatment of the disease, the lecturer said that no one can approach a case of typhoid fever without paying some attention to hygiene. This, he claimed, was of the greatest importance, and with it he would prefer to carry any one through the disease by wines and soups and fresh air, rather than by the use of drugs.

ALCOHOL IN THE LIVER AND URINE.

BY A. BÉCHAMP.—The entire liver of an animal just killed, when washed with distilled water and immersed in creosoted water contained in a vessel from which all air has been expelled by a current of carbon dioxide gas, soon begins to disengage carbon dioxide, hydrogen, and a little hydrogen sulphide. In three or four days, the liver and the water in which it has been lying are found to have become very acid without having acquired any putrefactive odor. On examination, notable quantities of alcohol and acetic acid can be detected, besides another acid which appears to be lactic acid.

The author has previously shown that a similar change

occurs within eggs, the contents of which have been broken down by violent shaking. The albuminoid matters in either instance take but little or no part in the phenomenon, while the glucose and glycogenic matters present disappear. The author attributes the fermentation to the action of the microzymas of the liver and of the yolk of egg, and the organic forms evolved from them. In the above experiment, the microzymas become, for the most part, evolved into bacteria, but the microzymas are themselves active.

There appears, therefore, no reason why alcoholic fermentation may not occur in the liver of a living animal, and the author has, consequently, sought for alcohol in the urine. This he has found in sufficient quantity to identify it by inflaming it, in the urine of elderly persons not making use of alcoholic drinks. The urine of younger persons does not yield equally decided results. (4)

URARI.

THE peculiar properties of the Urari poison are due to the presence of the alkaloid urari or curarin, discovered by Boussignault in 1828, but first produced in a pure crystallized state by Dr. Preyer, of Bonn, in 1865. Many eminent physiologists have studied its effects, but their experiments have not yet dispelled the mystery which has always attended it. It appears to act upon the muscles, causing death by paralyzing the heart or the muscles of respiration. Animals on receiving it into their blood soon fall into a stupor, the pulse becomes strong and rapid, the breath hard and accelerated, the muscles, after a convulsive motion, are paralyzed, the body becomes cold, and death ensues in five to thirty minutes, according to the size of the animal and the strength of the poison.

According to the experiments of M. Goudot, birds seem most susceptible to its effects, then mammals, then reptiles. The experiments of Prof. William North Rice, made in connection with last summer's work of the United States Fish Commission, show that mollusks are not in the least affected by it.

Urari has been employed in medicine as a specific for epilepsy, but the success of the experiments was not such as to recommend its general use. We have frequently seen it used to paralyze a frog, preparatory to placing it under the lecturer's microscope to demonstrate the circulation of the blood.

The Indian arrow-poison is known by various names; that prepared on the Orinoco as Urari or Curari, that from the Guianas as Urali, that from the Amazons as Ti-

cunas. The usage of different writers and the interchange of *r* and *l*, practiced by the South-American Indians, have given rise to multitudinous variations, such as Urari, Woorari, Woorara, Oorara, Urali, Wourali, Ulari, Curare, Curari, and Voorari. Some fixed orthography seems eminently desirable, and Urari seems to have the sanction of the best authorities.

Below is given an account of the mode of preparation in the words of Charles Waterton, who early in the present century made a long and perilous journey into the interior of Guiana, expressly to collect the poison.

"When the Macoushi Indian prepares his poison, he scrapes the Wourali vine and a bitter root into thin shavings, and puts them into a kind of colander made of leaves; this he holds over an earthern pot, and pours water on the shavings; the liquor which comes through has the appearance of coffee. When a sufficient quantity has been procured, the shavings are thrown aside. He then bruises some bulbous stalks which he has gathered, and squeezes a proportionate quantity of their juice through his hands into the pot. Then the pounded fangs of the Labarri and the Counacouchi snakes are added, a quantity of the strongest Indian pepper and of two species of ants are thrown into it. It is then placed on a slow fire, and as it boils, more of the juice of the Wourali is added, according as it may be found necessary, and the scum is taken off with a leaf; if remains on the fire till reduced to a thick syrup of a deep brown color. As soon as it has arrived at this state, a few arrows are poisoned with it, to try its strength. If it answers the expectations, it is poured out into a calabash, or little pot of Indian manufacture, which is carefully covered with a couple of leaves, and over them a piece of deer's skin, tied round with a cord. They keep it in the most dry part of the hut; and from time to time suspend it over the fire to counteract the effects of dampness." (119)

POISON AND VENOM.

MR. A. MURRAY says: "Poison and venom are often used as convertible terms. I do not understand them to be so. Poison properly means something which injures the system by introduction through the stomach. Venom something which injures by introduction through lesion of the tissues. Most poisons are also venoms; whatever injures if introduced into the stomach will most probably also injure if introduced directly into the blood. But the converse is not true; most venoms are not poisons—that is, it is not by digestion and assimilation that they work, but

by entering the vascular system from without. It is said that you may swallow the venom of a rattlesnake with impunity; and I imagine you may if it is not absorbed through the mucous membrane, but Dr. Fayzer's experience, lately published, of the effects of the semi-swallowing which occurs in extracting the venom from a poisoned wound by sucking, would rather seem to show that such extremely virulent venom would penetrate the mucous membrane, and act as if actually introduced by a wound, his throat having become dangerously ulcerated from sucking the poison from the wound of a man bitten by a cobra. There is yet another way than by swallowing or being wounded, by which venom may injure, and that is through the nervous system, by application to the skin. This is the way in which the nettle must sting. In that case there is not the smallest lesion in the skin, and if the nettle were artistically made to touch the open surface of a gaping wound, it would not sting at all; neither is it by mechanical irritation that the pain is caused. The nettle has a venom-gland as well as the rattlesnake, and it is the application of this venom to the delicate terminations of the nerves in the skin that produces the pain.

"Though the majority of insects introduce their venom through the agency of an instrument provided for the purpose, there are some which do not, as the *Kaa* of Africa, which is used as a poison for their arrows by the Bushmen. Dr. Welwitsch had a personal experience of the severe swelling and pain in every part of his body which he touched with his hand after collecting specimens of these insects in their caterpillar state. He had, in consequence of a warning, carefully avoided touching them, shoving them into a phial with a straw; but whether he had inadvertently touched them or fingered the leaves on which they had been feeding, (which he collected for examination,) he and his servant were both laid up helpless for two or three days."

MERCURY POISONING.

In Vienna, recently, Professor Hyatt delivered a lecture on mercury, when he exhibited the leg-bone of a man whose death had undoubtedly been hastened by that substance. On striking the bone heavily upon the table, out fell thousands of little glittering globules of mercury, which rolled about upon the black surface before him, collecting here and there into drops.

In this country, metallic mercury has been found in old graves, in connection with human bones.

ELASTIC PROFANITY.

AT a summer festive gathering on one of the Thousand Isles of the St. Lawrence, last season, the Rev. Dr. Pullman, of Peoria, playfully gave, as a complimentary toast, "The health of the inventor of Elastic Profanity," in allusion to Dr. S. C. Barnum, of New-York City, who happened to be present, and who is well known in the dental profession as the author of the *rubber dam*. This is a device now in common use, for keeping fillings dry during the operation of tooth-plugging, and is almost as indispensable for good success in dentistry as chloroform is in surgery.

The rubber dam is nothing more than a piece of sheet rubber, which is punctured and stretched over the necks of the teeth, serving to hold up the gums and wholly prevent the access of saliva at the point where the filling is being introduced. It is not only a marvelous convenience for the dental operator, but affords great relief to the patient; for it in no way interferes with the natural functions of the tongue, muscles, and glands of the mouth. It enables the dentist to perform with ease and certainty a class of most necessary operations which were previously counted almost among the impossibilities by leading practitioners. In thousands of cases, teeth which before were condemned for extraction are now readily saved and filled.

The rubber dam was invented in 1865, by Dr. Barnum, and presented by him as a free gift to the profession, at the Dental Convention held in this city during that or the following year. Previous to the discovery of this device, dentists were obliged to resort to all sorts of curious contrivances in the attempt to keep their fillings dry. Among these was the duct valve, a round disk which was placed in the mouth of the patient, upon the orifice of the salivary gland, and there pressed by a clamp, to prevent the escape of the saliva. This was painful to the patient, as well as injurious, as it caused an unnatural engorgement of the gland.

Then there was the saliva pump. While the dentist was engaged in filling the tooth, an attendant stood by and worked a hand-pump to draw off the saliva from the patient's mouth. Sometimes the dentist had to take plaster casts of the defective tooth and adjacent parts, and by their aid manufacture temporary bulwarks of gum mastic, to fit the mouth, with a view to shut off the water from the designated tooth. This preliminary operation involved much more time and trouble than the filling of the tooth.

Then there were the tongue clamp, the gum clamp, the

gag, the iron presser, and other special tormenting devices, which were brought into operation for the one purpose mentioned; to say nothing of sponges, blotting-paper, and cloth napkins, with which it was deemed necessary to stuff and torture the patient's mouth. All of these relics of what may be termed the dark age of dentistry have been superseded by Dr. Barnum's rubber dam. The author occupies a high place in the estimation of the profession, by whom he is justly regarded as a benefactor; while every dental patient who remembers the old instruments gives honor to the inventor, and rejoices with elastic profanity. (83)

REMEDY FOR HOARSENESS.

A WRITER in the *Medical Record* commends the use of borax as a remedy for the hoarseness or loss of voice common among public speakers and singers. A few minutes before any continuous exercise of the vocal organs, a small lump, three or four grains, of borax is to be slowly dissolved in the mouth and gradually swallowed. The solution acts upon the orifice of the glottis and the vocal cords precisely as "wetting" acts upon the notes of the flute. It is also stated that five grains of nitre taken in a glass of water, the body being wrapped in extra clothing, will excite a gentle perspiration for an entire night; and this treatment will break up a cold if employed at its first onset.

MOSQUITO-NETTING AS A SURGICAL DRESSING.

THE *Medical Record* remarks that in all those cases where it is desirable to keep up support and pressure, and at the same time permit the free escape of all discharges from the wound, or ulcer, or whatever it may be, the ordinary mosquito-netting, used for a bandage, meets all the indications. Bundling dressings are avoided in this way, the parts are kept cool, the discharge goes on unrestrained, and at the same time support is maintained. If the discharge is considerable, a pad of oakum may be placed beneath the parts to secure the discharge, thus insuring perfect cleanliness. This netting serves an admirable purpose in dressing large abscesses; for instance, when compression and free discharges are to be associated.

POISON-BOTTLES.

A BOTTLE studded with knobs, and intended to hold poisons, has been patented in England. By the use of this bottle, many fatal mistakes will be obviated. The knobs will signal to the touch the nature of the contents of the bottle quite as effectually as a label would signal it to the eye.

INFLUENCE OF CHANGES IN BAROMETRIC PRESSURE ON THE PHENOMENA OF LIFE.

BY PAUL BERT.—In dogs, convulsions begin when the external pressure of oxygen is about $3\frac{1}{2}$ atmospheres, or 17 atmospheres of air, and death occurs at 5 atmospheres of oxygen. From an examination of the blood, he finds that oxygen acts as a rapid poison when the quantity present in arterial blood rises to 35 per cent. This is not quite double the normal amount. Poisoning by oxygen is characterized by the presence of convulsions, which, according to their intensity, resemble various forms of tetanus, epilepsy, or poisoning by strychnine or phenol. They are due to an exaggeration of the excito-motor power of the spinal cord, and are temporarily arrested by chloroform. They are accompanied by a considerable and constant diminution in the internal temperature of the animal. (4)

THE MUSCLES.

M. RANVIER points out that the red and white muscles of a body—very clearly seen by removing the skin of a rabbit—which exist mingled in the same region, are different both in structure and properties. On applying the electric current, the white portions contract almost instantly, and respond even to rapid and continuous shocks. The red portions, on the contrary, are much more sluggish; it requires a certain time for them, apparently, to feel the excitement, while, on quick, interrupted discharges of electricity being administered, they simply assume permanent contraction. It is believed by M. Ranvier that the contractions are involuntary, and of the same nature as those of the muscles of the heart; the former, however. he thinks, are controlled by the will.

A REMARKABLE POISON.

THIS poison is obtained by pressure from the seeds of *strophanthus hispidus*, an apocynaceous plant, found in Africa; and from experiments made with samples of it, taken from arrows upon which the natives place it, it appears that it acts more powerfully than digitaline or antiarine, and quickly paralyzes the heart. The $\frac{1}{11000}$ of a grain will kill a frog, a sparrow, or a dog, though the resistance of certain animals varies. A snail, for instance, requires $\frac{1}{10000}$ of a grain; a mouse has withstood $\frac{1}{11000}$ of the extract, (obtained by macerating the seeds in alcohol,) while the latter dose kills a dog nearly a thousand times heavier than the mouse. The heart comes to a complete standstill after a few irregular efforts.

CURE FOR HYDROPHOBIA.

THE following recipe, it is alleged by Franklin Dryre, of Galena, Maryland, is a sure cure for hydrophobia, the lives of many bitten persons having been saved by its use: "Elecampane is a plant well known to most persons, and is to be found in many of our gardens. Immediately after being bitten, take one and a half ounce of the root of the plant—the green root is perhaps preferable, but the dried will answer, and may be found in our drug-stores, and was used by me—slice or bruise, put into a pint of fresh milk, boil down to a half-pint, strain, and when cold drink, fasting for at least six hours afterward. The next morning, fasting, repeat the dose, using two ounces of the root. On the third morning take another dose, prepared as the last, and this will be sufficient. It is recommended that after each dose nothing be eaten for at least six hours."

EVERY one is familiar with the fact that a considerable degree of pain is felt upon immersing the hand in cold water. If the hand be plunged into ether the result is similar, and quicksilver at a low temperature produces even more intense pain. Horvath, a German physiologist, in making some experiments upon frogs, not long since, accidentally ascertained that the fingers may be immersed in alcohol of a temperature not above twenty-five degrees Fahrenheit, without any sensation of pain or cold being experienced. This discovery led him to apply alcohol to wounds occasioned by burning, and the results have been eminently satisfactory. Upon immersing the burnt surface in the alcohol, the pain ceased at once, and a cure was apparently hastened. As the fatal termination in cases of severe burns is largely ascribed to the continuous character of the pain, the importance of Horvath's discovery is evident.

COLOR-BLINDNESS.—An instrument has been invented in Germany for testing color-blindness. It consists of a rotating apparatus, which moves a disk whose centre is a circle, one half black and the other white; outside of this is a ring half red and half green, then another ring of violet and red, then the outside ring of violet and green. When rapidly rotated, the centre appears to be colored gray, that is, black and white mixed. To a green-blind person the middle line will appear gray, that being the result to him of a mixture of violet and red. The outer ring will appear gray to the red-blind patient, and the inner, gray to the violet-blind. By the use of this instrument, a large number of patients may be simultaneously examined for one or more kinds of color-blindness.

PISCICULTURE.

PRACTICAL FISH CULTURE.

BY FRED. MATHER.—There are three ways by which trout are increased in ponds and streams; first, by making spawning-places and allowing the fish to make their own nests in which they spawn, and the young hatch without further aid from man; second, taking the eggs from the ripe fish, impregnating and hatching them; third, by making nests in the ingenious contrivance known as Ainsworth screens, where the fish lay their eggs in gravel that rests on wire-cloth, and it is caught on a finer screen below, from which it is taken to be hatched in the same manner as those taken by hand.

In order to clearly describe the last two processes, it will be necessary to show how the fish deposit their ova when left to themselves. It is always interesting to lie at full length upon the board covering of the spawning race and watch the proceedings below through the cracks; and notwithstanding the fact that the writer has done it hundreds of times, it is not only just as interesting as ever, but as unsatisfactory, for there are some parts of the operation about which there seems to be as much obscurity as ever. Most, if not all efforts at pairing seem to be on the part of the males, who often appear on the spawning-beds several days before the females, and when the latter arrive and begin the nest-making, each one is appropriated by one of the sterner sex, who keeps close to her unless driven off by some more powerful rival. The female pays no attention to these skirmishes, but busies herself in making an impression in the gravel wherein to deposit her treasure. This she does by turning on her side and whipping the gravel with a succession of short, quick strokes of her tail, which causes her to move forward and upward until she is beyond its reach, when she again returns to her position to rest. The male fish now renews his attentions by rubbing against her sides, sometimes going clear around her head, all the while trembling with excitement, until the spectator can almost imagine he can hear a rumbling sound as he rounds the point of her nose.

This is kept up until a nest is made several inches deep and a foot or more in circumference, which sometimes occupies two or three days. When all is ready, she depresses her abdomen by bending her head and tail upward, and by gently pressing against the stones as she

moves forward, the eggs flow in an amber stream. The male, watchful of every move, seems to know the exact moment, for both seem to move by one impulse, and discharge eggs and milt together, which are then covered up, but whether by one or both I have never been able to determine. Some say the male alone does this, but there is always a great flurry and a cloud of milt that has prevented close observation.

It often happens that when two ripe males are battling for possession of a female, the fight ends in the death of one or both. A fin will be torn out, or scratches on the sides from the adversaries' teeth will have caused a slower death from the fungoid growth with which the wounds will be covered.

For ponds and streams where the trout are to be left to do their own spawning, all that is necessary is to provide graveled beds in or near a spring if possible, or just below an eddy formed by a log or stone, where the water is not too swift. The beds should be covered over by boards, which not only prevent their being disturbed by the sight of persons or animals passing, but also gives the fish a feeling of security.

The increase is very small by this method, as the eggs that are laid by one pair are thrown out and devoured by the next fish who may happen to choose the same locality for a nest, still it is much better than nothing if the owner is not able or inclined to do more. The first artificial pond that the writer ever saw was managed in this way, and the owner took many trout for his own use from it each year, besides allowing a limited number of visitors to fish in it at one dollar per pound.

This pond was 80x100 feet, and from one to nine feet deep. It was simply scooped out with a plow and scraper below a couple of small springs, which were made into spawning-beds, and a ditch plowed around the pond to carry off the surface water. (119)

AMERICAN FISH-CULTURISTS' ASSOCIATION.

At the last annual meeting, New-York, numerous topics connected with fish-culture were brought forward, and a committee was appointed to memorialize Congress, asking for an appropriation of $30,000 for the promotion of the culture of food fishes.

In a paper by Professor Mather, on artificial spawning as practiced in the cultivation of trout, the opinion was expressed that, contrary to the views of most fish-culturists, natural spawning is preferable to artificial in every respect.

Mr. Charles Bell read a paper on the fecundation of fish, in which he denies that the spermatozoa are distinguishable as independent organism, instead of being simply free moving cells. A communication was presented by Mr. George Sheppard Page upon fish-culture abroad, embracing the results of inquiries made by him, through the State Department, in China and Japan, in regard to the practice in those countries. From this it would appear that artificial culture, as we understand it, is unknown in those regions, efforts there being limited to the gathering of the spawn, as naturally impregnated, and hatching them out; and also keeping fish in reservoirs, where they can spawn, or where they can receive considerable accession of growth. Mr. A. P. Rockwood enumerates the native fish of Utah, among them including the lake trout, which sometimes weighs twenty-five pounds, the brook trout, weighing from one to three pounds, the sucker, chub, and a fish something like the cat-fish.

DECLINE OF THE CALIFORNIA FISHERIES.

A STEADY decline in the quantities of fish of most varieties taken in these waters has been noted for some years, but the effect of a destructive agency of some character has been particularly remarked the present season. Salmon and other choice species of fish have been scarce in the market as compared with former times, and the prices have ruled high. In fact, fish are not as cheap or abundant in this market to-day as in Eastern cities, where the supplies are procured from remote fisheries. The poor man's reliance, the herring, which formerly swarmed the waters in dense shoals, is becoming a luxury, from the decreased supplies, and only the unsavory sturgeon seems to hold its own defiantly and multiply in the muddy sloughs. The belief has been expressed that the sea-lions are principally responsible for the depopulation of the waters, but those who are acquainted with the habits of those animals assert that such is not the case; and very plausibly too, for the monsters were doubtless quite as numerous and as voracious a score of years or a century ago as at the present time. Another explanation which is now given is the ravages which the Chinese are making upon the young fish. Hundreds of these assumed despoilers of every blessing are employed constantly in catching the young fish, including every species in the bay just developed from the ova, in which work they employ fine nets, scoops, and other effective methods. This material is esteemed a prime delicacy among the heathen, large quantities being consumed in the city, and the busi-

ness of preserving the young fish and shipping them to China has become an important enterprise. Thousands of young salmon, from two to four inches in length, may be found among the large supplies brought in daily to the fish-shops in the Chinese quarters, and this is undoubtedly the true explanation of the alarming decline in the quantities of the best fish. This process continued for a few years will render salmon and other favorite species a rarity in these waters, and some enactment seems to be called for to afford protection from this particular encroachment of the Chinese scourge. (115)

FISH CULTURE IN NEW-ZEALAND.

LAST January, a large quantity of salmon-eggs from English waters was shipped to New-Zealand. They would reach their destination in 112 days, but it was a question whether they would bear so protracted a journey, though carefully packed and surrounded by ice. To determine this question, four boxes of ova, packed after the same manner as those sent to New-Zealand, were deposited at the office of a London ice company. After the lapse of 112 days, these boxes were opened, and the temperature was then found to be 38° Fahr. "In one of the boxes," writes Mr. Buckland, "the eggs nearly all contained living fish; in another they were 'blind'—that is to say, no embryo could be seen in them. In all the boxes there was a certain percentage of eggs which had turned quite white. Some of these white eggs presented a curious appearance—namely, a spot exactly the color of a strawberry, which covered a third of the surface of the egg."

The experiment was, on the whole, satisfactory, and proves that salmon-eggs may be kept in a healthy condition for 112 days or longer. It is still a question, however, whether the rivers of New-Zealand are suited for the cultivation of salmon. Some years ago, 1200 trout-ova were shipped to Victoria, and recently Mr. Buckland received from that colony a trout weighing 7½ lbs. If salmon thrive equally well in Australasian waters, this essay in "practical natural history" will be productive of immense benefits to the British colonies in the South Pacific at no distant day.

FISH CULTURE IN CHINA.

A FRENCH official, M. Dubry de Thiersont, writing from China, states that fish culture has for thousands of years been an important branch of industry among the Chinese.

They selected the best kinds of fish for breeding, calling them family fish. Most of those employed belong to the cyprine family, are hibiverous, fatten fast, and grow ra-

pidly to a large size. Nearly every farm had its fish-tank or pond, and the care of its inmates was as constant a duty as that of any other stock. It is only recently that artificial fish culture has been introduced, and the Chinese maintain that fish so bred quickly degenerate. The method they adopt is to collect the young spawn or fry and then bring them up in the natural way. The ponds and tanks of the interior provinces are yearly supplied in this way, and during the season for fishing are regularly drawn upon as sources of food. Laws for the protection of fish are stringent and thoroughly executed. The management is placed in the hands of mandarins, each of which has charge of a certain district. Their business is to see: 1st. That at given periods of the year, a quantity of fry in proportion to the extent of the district is turned into its waters. 2d. That during the spawning season, the communications between the lakes and rivers are free so that fish may deposit their spawn. 3d. To prevent any person fishing between the months of April and September, and to take care that nothing is done to injure the fish in any way. The great rivers which fall into the sea are open to fishermen throughout the year, and the minor rivers for nine months; but the lakes and smaller streams are only fished from September to April. These regulations and the universal adoption of fish-ponds and tanks in which the so-called family of domestic fish are preserved and fattened, give to the inhabitants an abundant supply of fresh-water fish, which for centuries has never failed even for a single year.

MAINE SALMON.

AN important enterprise has lately been initiated by the Fish Commissioners of Maine, Massachusetts, and Connecticut, together with the United States Fish Commissioner, looking toward the multiplication of land-locked salmon in Maine, and the securing of a supply of eggs for distribution to appropriate localities in other States. This fish, as may be known to many of our readers, occurs in the St. John River, New-Brunswick, in the Schoodic lakes, in the upper waters of the St. Croix, in Reed's Pond, and in Sebec and Sebago ponds, and possibly in other localities, and is to all intents and purposes a specific race of salmon, varying in its average weight, according to the locality, from two to five pounds, and while possessing the full flavor of the salmon, having at the same time all its game qualities, and thus making it a desirable fish for the sportsman. It is admirably adapted to the great Northern lakes of the United States, including those of New-York, Pennsylvania, Ohio, Michigan, Wisconsin, etc. During the

month of August, the gentlemen referred to visited various points, and finally fixed upon Sebec Lake as the scene of their operations, where they are now about erecting a hatching-house, and where, under the direction of a competent superintendent, it is proposed to collect the eggs of this fish and develop them to a sufficient degree for transfer to other waters. By the laws of Maine, one fourth of all the spawn taken must be returned to the lake, so that the principal benefit of the enterprise will inure to the waters of Sebec.

THE GROWTH OF SALMON.

By C. E. Fryer.—But very few people, probably, know what sort of appearance this beautiful fish presents in its infancy. Hidden away during that period in the upper waters of our salmon rivers, and ultimately in the depths of the sea, it is lost to sight till it grows large enough to be taken by the salmon-nets; and, until lately, very little was known of its natural history, or of its habits, though the experience of the last few years has revealed many interesting facts concerning the development of this fish, through the egg, fry, smolt, and grilse stages, till it becomes a full-grown salmon.

Fig. 1.
NEW-LAID SALMON EGG.

Fig. 2.
EGG AFTER ABOUT 35 DAYS.

Fig. 1 represents the egg—natural size—of a salmon just laid. Each female salmon carries, on an average, 800 to 900 of such eggs to every pound of her weight. They are generally of a pinky opal color, elastic to the touch, covered with a soft, horny membrane, with a minute opening through which a particle of the spawn—the soft roe—of the male fish enters, and the egg is fertilized. From this moment the young fish gradually develops under the influence of the cold running water. At the end of about thirty-five days—more or less, according to the temperature, which should be about 40°—two little black specks can be seen, as at Fig. 2, which are the eyes of the embryo fish; the vertebræ may be discerned in the form of a faint red line, and a small red globule, which shortly afterward appears, represents the vital organs of the embryo fish.

At the end of about 80 to 100 days from the deposition of the egg, the fish has so increased in size that it bursts the "shell" and makes its *début* in the form represented at Fig. 3. The sac or umbilical vesicle attached to the under part of the fish contains a secretion resembling albumen, which affords nourishment to the infant fish for the first six weeks or so of its existence. By that time, it is quite absorbed, and for the first time we see a perfect fish, Fig. 4, with its fins, gills, and scales, which have hitherto been present, but imperceptible except under the microscope, fully formed; and now the young salmon begins to feed. His growth is not very rapid for some months, the lines *a*, *b*, *c* representing the average length of a salmon at two, three, and four months old. At two years old, the fish is about nine to twelve inches long.

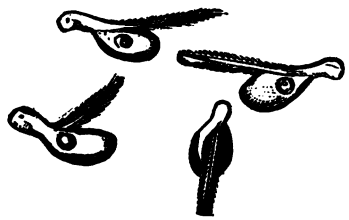


FIG. 3.—FISH COMING OUT OF EGG.

As soon as they are large enough and strong enough, the "smolts," as they are now called, descend to the sea; here they are lost sight of until they return up the river as "grilse." The actual duration of their stay in the sea is not yet known, from one to three years being variously estimated as the probable length of time. The object of this migration to the sea is to find the food which is necessary for the secretion of the fat of the fish, who live on the *infusoria*, smaller fish and crustaceans, and the spawn of sea-fish, which abound in our seas. The length of their stay in salt water is regulated, no doubt, by various circumstances, and is not the same in every case. When the salmon has laid up a sufficient supply of fat in its body and on its pyloric appendages, which are a wonderful provision of nature for the secretion of an amount of fat sufficient to supply it during its sojourn in fresh waters, it ascends the river, its roe or spawn developing as it ascends; till, about Christmas-time, or sometimes earlier, it reaches the shallow head-streams of the river, in the gravelly beds of which it deposits its eggs, returning immediately afterward to the sea, no longer in the bright, plump, muscular condition in which it ascended, but a lean, lank, ugly, wounded beast, which one would hardly recognize as *Salmo salar*. A salmon which has newly spawned is called a "kelt." The curved projection, or

hook, on its lower jaw is a cartilaginous membrane, the use of which nobody knows. A "kelt" was found dead on the banks of a Welsh river; it was in a very weakly condition, his fat gone, and he had perhaps assumed this appearance to frighten other animals which might otherwise have been tempted to attack him. This fish, had it survived, would have returned to sea, recovered its fat, and presently come back worth £2 or £3, whereas, by dying in this condition, it was worth nothing. It had, however, done its duty by depositing perhaps 16,000 eggs. Only a very small percentage, however, of the eggs laid ever become adult fish. Floods wash them out of their gravel nests; ducks and other birds eat them; beetles and various insects attack them; they are smothered with mud, or left high and dry on the shore; the young fish

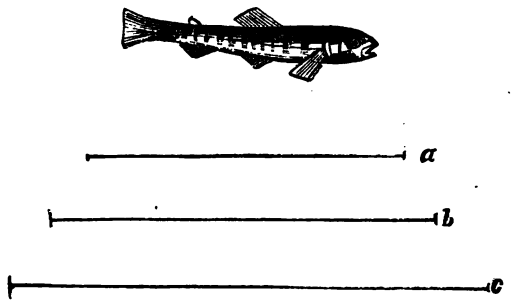


FIG. 4.—YOUNG SALMON SIX WEEKS OLD.
a, *b*, *c*, size of salmon at two, three, and four months respectively.

are poisoned by pollutions, or diverted into mill-leats and canals, and so lost; trout eat them wholesale; in fact, the whole of their earliest existence is a very living death, and it is a wonder, with all the ordeals they have to pass through, that we have any salmon left. To kill them legitimately for food for ourselves is bad enough, and we ought to do all we can to protect them when young.

In the artificial system of breeding salmon, the adult fish are caught just as they are on the spawning-beds, and the eggs taken from them; the ova and milt are properly mixed together, and the eggs placed in troughs of water so arranged as to imitate as closely as possible the natural conditions necessary for the development and growth of the fish. Properly managed, ninety per cent of the eggs will hatch out; the young fish are turned into the river when they are about a year old; if they can be kept two

years in tanks large enough, with plenty of running water, so much the better for the prospect of their reaching the sea in safety.

When we can make up our minds to keep all our pollutions out of our rivers, and build "salmon-ladders" over all the wears, so as to give the fish a fair field, and enable them to run up-stream unimpeded, then, and then only, shall we see salmon as plentiful throughout the country as it is said to have been in the North a century ago, when apprentices are reputed to have stipulated in their indentures that they should be fed on salmon not more than three days a week. Without this, all our efforts to stock our barren rivers with artificially-bred fry will prove comparatively unavailing. (47)

THE SACRAMENTO SALMON.

LIVINGSTON STONE, the indefatigable gentleman who had charge of the U. S. Salmon Breeding Camp on the McCloud River, Cal., writes to the *Forest and Stream*, from his "Cold Spring Trout Ponds" at Charlestown, New-Hampshire, under date of November 19th, 1873, as follows:

"Our operations this year in getting salmon spawn in California were more successful than they were last year. Last year, I received my instructions barely in time to reach the spawning-grounds of the salmon by the first of September. The McCloud River, which offered the best facilities for the work, is inhabited only by Indians, and our nearest source of supplies at that time being at Red Bluff, fifty miles distant, it was the middle of September before we could get to work to collect the eggs.

"Judging from precedents at the east, where the salmon never spawn before October, we supposed we had plenty of time, but to our astonishment, we found on catching the parent salmon that they had nearly all spawned, the season here being at least six weeks earlier than on the eastern rivers—the Minimichi, for instance, where the salmon begin to spawn about the 15th of October. It was too late to make a great success that year, so we contented ourselves with taking a few thousand eggs, and waiting till the next to complete the experiment. It was the fault of no one, for after the funds were ready for disbursement at the Treasury Department, not a day was lost in pushing the work to its accomplishment.

"This year, however, I started in good season, and on the 19th of August the water was turned on to the hatching-troughs and every thing was ready for collecting eggs. We considered the day an auspicious one for this event, be-

cause on the same afternoon about sundown, with the help of our whole force of whites, and a dozen Indians, we erected a fifty-feet flag-staff and hoisted a large American flag over the camp.

"On the 26th of August, 1873, we took the first salmon eggs, 23,000 in number, and continued taking eggs from this time till the 22d of September. The number which I was instructed by Prof. Baird, the head of the United States Fish Commission, to furnish was one million, but knowing the great liabilities to loss in hatching and transportation, I took two million eggs in all, allowing 500,000 for waste in hatching, and 500,000 for loss in transportation. On the 12th of September, the first eye-spots made their appearance, and on the 20th of September I sent eastward the first shipment, numbering 300,000. The balance of the eggs, as they became properly matured for forwarding, was shipped at intervals up to the middle of October, when the last of a quarter of a million was packed and sent to Dr. Slack, of New-Jersey.

"The waste in hatching and transportation was about what was provided for, so that very nearly the stated quota of a million eggs arrived at their destinations alive.

"They were sent in various proportions to Dr. J. H. Slack, New-Jersey; Mr. James Duffy, Pennsylvania; George H. Jerome, Michigan; Seth Green, New-York; Charles G. Atkins, Maine; E. A. Brackett, Massachusetts; F. W. Webber, New-Hampshire; A. P. Rockwood, Great Salt Lake, Utah. Their final destinations are the Susquehanna, Potomac, Delaware, Schuylkill, and James Rivers; Lake Superior, Lake Champlain, Great Salt Lake, and the tributaries of the Mississippi.

"Very truly yours, LIVINGSTON STONE."

It will be perceived that the waters of the Hudson are not included in the distribution designated above, inasmuch as our correspondent had not been advised, at the time of writing, of the determination of the chief of the Fish Commission to include the Hudson, as announced in the last number of *Forest and Stream* over his own signature. There can be no doubt of the wisdom of Prof. Baird's decision in this matter, for certainly no waters are better adapted for salmon propagation and growth than the clear, cold tributaries of our noble river; and those gentlemen who have urged it upon his attention through the columns of newspapers are very competent to judge of the whole subject in all its bearings, *ab ova usque mala*. We are informed that the young fry will be ready for planting in about a month. They should go into spring

brooks of a very few feet in width, which are not likely to freeze during winter.

One of our worthiest and best informed correspondents, J. Carson Brevoort, Esq., earnestly opposes putting these fish in the Hudson. He says they are a heavy, slow, and logy fish, that do not take a fly and are not very delicate as food. But for all this, we will not allow our noble river to remain barren of fish. These salmon will serve as fish food and be taken in abundance with the shad in nets in years to come. And albeit they are now coarse in flesh and afford the angler no sport, they will improve in flavor in due time, and also adopt the habits of their Labrador kinsfolk, and rise to the fly as gracefully as the best educated of them all. And if they should herein disappoint these cherished hopes, what of it? We can still go to the St. Lawrence or the Bay Chaleur for our rod-fishing, as we now do, while the poor will be fed on salmon at prices within their reach. (119)

NEW SALMON.

AN augury of the success of the measures now being taken to introduce the salmon into those waters of the United States that have hitherto been untenanted by them is shown in the results of the experiment in the Delaware and Susquehanna rivers. It is said that not unfrequently young salmon have been taken in the former river three or four inches in length, being the progeny of the eggs spawned at Bucksport, Maine, and hatched out near Easton, Pennsylvania, in the spring. We also learn that the young Sacramento salmon hatched out by Dr. Slack, and placed in November last in the Susquehanna River near Harrisburg, have several times been taken of a length of seven or eight inches. They appear to be admirably well adapted to their present abode, and it is expected that their number in the Susquehanna will be greatly increased during the present autumn by a new stock soon to be forwarded by Mr. Livingston Stone from his establishment on the M'Cloud River, a tributary of the Upper Sacramento. (120)

PROGRESS OF SALMON CULTURE.

THE experiment of introducing salmon into the waters of the Eastern United States gives brilliant promise of success, as we learn from the Germantown *Telegraph* that young salmon from two to four inches in length have been taken in the Delaware in bait-nets, and carefully returned to the river, one party having captured over fifty in a single day. It will be remembered that 40,000 salmon-eggs from the Bucksport establishment were assigned to Penn-

sylvania by the United States Fish Commissioner, and placed in charge of Mr. Thaddeus Norris, who, with the assistance of Mr. H. J. Reeder, hatched them out at Heitzman's Spring, near Easton. Twenty-seven thousand five hundred healthy fish were introduced at the proper season into the Delaware.

THE GROWTH OF FISHES.

IT is stated that "some years ago Prof. Agassiz suggested to George S. Page, of New-York, President of the Oquossoc Angling Association, a method of determining approximately the age of the famous Rangely trout, which grows to the weight of seven, eight, and even ten pounds. The mode adopted was to take a small platinum wire, pointed at one end and flattened at the other, and marked at the flat end with the weight and the year. Then insert this wire in the dorsal fin, selecting a mark according with weight and time, and return to the water." It seems that in 1870, fifty trout were caught and marked in this manner and returned to the water. This year, among a lot caught by the artist Moran and some friends, was one marked 1870—weight, half a pound. It weighed nearly 2¾ pounds, showing an increase of nearly 1¾ pounds in three years, or a little over half a pound a year. Now, this may be a very fair test for that particular lake, but the annual growth of fishes depends so much on circumstances that it is impossible to establish a general rule from any local test. The increase of all fishes changes materially, both with abundance of feed and extent of range. A difference arising from kind and abundance of food would be expected, but it is not so easy to see why extent of range should have so marked an effect on size. Yet, you put a trout in a well or small spring, and give it all the food it will eat, and its annual increase is hardly perceptible. But give it wide range and a full supply of food, and it increases rapidly. One might think that its cramped condition in a well by confining its exercise destroyed its appetite, and so prevented its eating a sufficient quantity to hasten its growth. But we find that fish vary in size according to the size of the sheet of water they are in.

This is true of catfish, every one knows, and of pickerel. In this State or New-England, take two ponds, only a quarter of a mile apart, and wholly disconnected—the one ten rods in diameter, and the other a half mile, and the pickerel in the latter, though in the same kind of water, and living on the same kind of food, will average nearly double in size those found in the former. I should like some explanation of this well-known fact. No man goes to a small pond for large pickerel.

The rapid increase in growth is still more marked, and often something marvelous, when the same fish is transferred to different waters in which is different food. I remember, twenty-eight years ago, when I was at Lake Schroon, on my first trip to the Adirondacks, a party of men brought in a large quantity of pickerel, some of them weighing ten, twelve, and one fourteen pounds. The fish had been put in the lake four years before, and an act of Legislature obtained forbidding any fishing in it for four years. The four years having expired, the fishing commenced, and the above was the result. Now supposing the largest taken was one of the original number put into the lake; he had increased nearly three pounds a year, or three times his size. This is wonderful. A still more remarkable instance has just occurred here in Long Lake and in the Raquette River. Four years ago, the last time I floated down this wild, beautiful river, no pickerel had ever been seen in it. Now it is absolutely swarming with them. They crowd it so that I verily believe a good fisherman might half fill his boat on a good day. The change has come about in this way: Five years ago, some men put thirteen pickerel in Long Lake, much to the disgust of the colonists there, who feared they would destroy the trout, as they doubtless will. That very winter four of the number were caught through the ice, leaving only nine to stock the lake and river. This year, or four years from the time they began breeding, the lake is found to be full of them, and the Raquette River also for 130 or 140 miles, clear to Potsdam. The original nine fish averaged about a pound in weight. This summer they take them weighing from two to twelve pounds. The other day, a son of my old Indian friend, Mitchell Sabbatis, a boy only nine years old, took one weighing seventeen pounds, or fully as long as himself. The fish towed him half across the lake, and how the little fellow managed to capture him is surprising. None but a young Indian could have done it; but he would have stuck to him till he was dragged overboard, and, I have no doubt, even after. Now, granting this to have been one of the original nine, he had increased about four times his size every year for four years. Others may have heard of such rapid growth before, but I never have. In four years those nine pickerel have stocked to repletion Long Lake, fourteen miles long, and Raquette River for over 100 miles, and Trapper Lake and several small ponds, till millions apparently swarm in them. At first sight, the increase in numbers may seem quite as marvelous as the increase in size, but on reflection it is not. It is doubtless owing to the fact that for some cause the

spawn escaped the destruction that usually overtake it. The pickerel, one of the most voracious of fishes, eats its own young in immense numbers, but the abundance of better food in these waters, especially such delicate morsels as young trout, would prevent this, and hence a greater proportion reach maturity. Now, I do not know how many thousand eggs are in pickerel weighing a pound, but there are more than one thousand. Supposing a fraction of these, say one hundred, reaches maturity, that would give from the nine pickerel nine hundred saved. The same ratio in four years would show the sum total of ninety millions—a number large enough to stock many a hundred miles of water. If the ratio saved was larger, the number would be proportionably increased. But with the increase of the size of the fish, the number of spawn would be doubled and tripled, so that the result would be still more astonishing. The fact is that the number of fishes that usually reach maturity in proportion to the eggs laid is infinitesimally small. (25)

PECULIARITIES OF ANADROMOUS FISHES.

ONE of these characteristics is the infallible instinct of finding their way back from sea to the river, the tributary of a river, or even a small affluent brook where they emerged from the ova. It has been pretty well ascertained that however they may mingle on their marine feeding-grounds, when they are impelled by the reproductive impulse toward fresh water, the Connecticut shad ascend that river, the Hudson shad again pass up between the New-York and New-Jersey shores, and that those of the Delaware are again and always will be Delaware shad. So also with herring and salmon.

At Little Russia, a point on the Bay of Chaleur, ten or twelve miles above Bathurst, the stake-nets set off from shore sometimes take salmon seeking the mouth of the Restigouche as well as that of the Nepissiguit, and the habitans who attend these nets will point out a fish of each river with as much confidence as a stock fancier would an Alderney or a Durham cow. The salmon—and it is so also with shad—of some rivers are inherently small, or of some known conformation—short or long—of others very large.

Another peculiarity of these fishes, which enter fresh rivers only to spawn—for the sea is their pasture-ground where they acquire growth, fat, and flavor—is that they are invariably found without food in any process of digestion in their stomachs after entering the fluvial portions of a river. That organ, after they have been in the rivers

a few days, becomes a contracted cord, in appearance not thicker than a pipe-stem, and filled with a hard cheesy substance, mixed, perhaps, with a little bit of yellow fluid. It is certain that the young of both of the fishes mentioned, until their first migration to sea, feed on flies, their larvæ, and on aquatic insects, which may be found in their stomachs; but on returning from sea to their native streams, it is solely that they may carry out the law of their nature to continue their species.

"Why then," the reader may ask, "does a sâlmon or shad rise occasionally to a natural fly or the counterfeit of the angler?" We can only refer such fact to a remnant of an old instinct or recollection of the food they fed on before their first migration to sea and their predatory habit. But the few natural flies they may devour do not, however, appear to distend the stomach in the least; no effete matter is pressed from the vent in handling them.

A young shad, according to Mr. Theodore Lyman, of the Massachusetts Fish Commission, during its sojourn in fresh water from the time its yolk sac is absorbed until it descends the river, is provided with teeth, which the adult shad has not. The naturalist mentioned has even found one or two small species of flies and the larvæ on which they feed in the stomachs of shad fry. (119)

FISH CHEMICALLY AND PHYSIOLOGICALLY CONSIDERED.

IN an interesting article, Dr. Wetherbee presents one of the views held on this subject as follows: By chemical analysis, it is found that fish contain a greater proportion of phosphorus than any other class of animal food, and therefore must be considered the richest "brain food." In land animals, the phosphorus is contained, for the most part, in the bones, in combination with lime, as a phosphate, while the muscle is rich in fibrine. But, on the other hand, the various genera of fish, although not abounding in fibrine, are much richer in phosphorus, and this element, as a general rule, varies according as the fish is lively or slow in its movements and habits. Upon this difference depends, in a great measure, the relative value of different kinds—those containing the greatest proportion of phosphorus, and, consequently, those of the most rapid movement, commanding the highest prices. Thus the salmon, a fish of remarkable agility in its movements, and its nearest relative, the trout, are among the most expensive of the varieties in our market, while the less active kinds command but inferior prices. Nations which eat fish with one meal a day are undoubtedly the most active in intellect, and the most capable of brain labor without

exhaustion or fatigue. Even those savage tribes which subsist, in a great measure, upon fish, no doubt possess very active, quick minds, although they are uncultivated and ignorant; and other causes may also tend to keep them in a deplorable and degraded condition. But when once civilized and Christianized, these tribes of *Ichthyophagi* become quick and active in intellect, even to put to shame the more stolid beef-eaters of the inland towns of Christian lands.

THE NEW-ENGLAND FISHERIES.

In compliance with a request from the Massachusetts Commissioners of Fisheries, Professor Baird writes an exceedingly valuable letter, assigning the causes for the present deficiency of fish supply on the New-England coast. Fifty years ago or more, the streams and rivers of New-England emptying into the ocean were at certain seasons almost blockaded by shad, salmon, and alewives going up to their spawning-grounds; and after these had returned to the ocean, their progeny swarmed to an almost inconceivable extent in the same localities, and later returned to the sea in immense schools. Meanwhile, cod, haddock, halibut, and the line fish generally, occupied the fishing-grounds close to the shore. But the dams erected upon the waters of the New-England States, and especially of the State of Maine, have long prevented the upward course of the anadromous fishes, and consequently these are now but rarely seen. Simultaneously the line fishes deserted the coast, and the reason of this is not far to seek: they found their natural food there no longer.

"It is therefore perfectly safe to assume," writes Professor Baird, "that the improvement of the line fishing along the coast of Maine is closely connected with the increase in number of alewives, shad, and salmon; and that whatever measures are taken to facilitate the restoration of these last-mentioned fish to their pristine abundance will act in an equal ratio upon the first-mentioned interest. The most important of the steps in question are the proper protection of these spring fish, and the giving to them every facility needed for passing up the streams to their original spawning-grounds; this is to be done, of course, by the construction of suitable fishways and ladders."

Of the alewife as a food fish, Professor Baird remarks: "Its value is not fully appreciated in our country. It is in many respects superior to the herring as an article of food; is, if any thing, more valuable for export, and can be captured with vastly less trouble, and under circumstances and at a season far more convenient for most persons engaged in the fisheries."

NO FISH IN THE MERCED.

IT is a curious fact, as reported by Mr. Livingston Stone, that there are no fish in the Merced River or any of its tributaries above the walls of the Yosemite Falls. The streams which unite to form the Merced above the falls are the Nevada or Main Stream, the Lenaya, the Illilonette, and the Yosemite, all well supplied with clear, cold, and beautiful water, but totally destitute of fish of any kind. Connected with these streams are nearly a hundred lakes, from two hundred yards to a mile in diameter, and equally destitute of life. The average altitude of these lakes is about 8000 feet above the level of the sea.

Mr. Stone suggests the expediency of stocking these waters artificially with trout, especially the *Salmo spectabilis*, which inhabit only the coldest waters of the Sacramento. But it may be a question whether it will be practicable to accomplish this purpose satisfactorily in the probable absence of a sufficient quantity of food, which perhaps more than any supposed inaccessibility may be the cause of their absence. Insect larvæ and crustaceans which might furnish nutriment to cyprinoid fishes, even if not fed upon directly by the *Salmonidæ*, are possibly unable to sustain the low temperature of the streams.

A similar absence of fish life to that referred to by Mr. Stone is seen in the upper waters of the Hudson in the Adirondack region. In ascending Mount Marcy *via* Lake Henderson, from the old Adirondack Iron-Works, Avalanche Lake, quite a large and deep body of water, is met with, and this is said to be uninhabited by any kind of fish; and it is quite certain that Opalescent River, the bed of which travelers ascend in climbing the mountain, and which is a stream of considerable size, is likewise entirely destitute of fish. The only form of animal life that was observed by a party of naturalists who were engaged in inquiry consisted in the larvæ of some species of salamanders, probably *Desmognathus fuscers*, the adults of which are very abundant on the upper levels of the mountain. (120)

SPAWNING OF THE STERLET.

ACCORDING to Professor Owsjannikow, the sterlet spawns in the Volga early in May, on rocky bottoms, the temperature of the water being at 54.5° Fahr. The eggs are readily fecundated by the artificial method. After they have been in the water a few minutes, they adhere to any object which they touch. The development of the embryo can be observed in progress at the end of one hour. On the seventh day they hatch. At first the young fish are

about one quarter of an inch long. At the age of ten weeks, they are nearly two inches long. They feed on larvæ of insects, taking them from the bottom. Both in the egg and when newly hatched, the sterlet has been taken a five days' journey from the Volga to Western Russia, and in 1870 a lot of eggs was carried to England to stock the river Leith. This species, like many other of the sturgeons, passes its whole life in fresh water.

GENERATION OF EELS.

MUCH uncertainty prevails in regard to the mode of generation of eels, and many contradictory views have been presented, none of them bearing the test of critical examination. This animal forms a remarkable exception to the characteristics of the anadromous fish, such as the shad, salmon, etc., which run up from the sea as mature fish, and spawn in the fresh water and return again; their young remaining for a time, then visiting the sea, also to return to the rivers when the sexual instinct seizes them. The eel, on the contrary, spawns in the sea, and the young run up into fresh water and pass the period of immaturity, then going down to the sea and remaining there, their young in turn pursuing the same round.

It is now announced by Ercolani, an Italian physiologist, that the eel is really a perfect hermaphrodite; that the genitals are only completely developed at sea, during the month of December; the ovaries and testes being together in the same animal, with spermatozoa; and he believes that the ova are fertilized there before their emission from the body. This is a very remarkable statement, but one that may, perhaps, prove to be correct; at any rate, it comes nearer to solving the problem of the generation of the eel than any suggestion that has hitherto been made.

HABITS OF THE BALTIMORE OYSTER.

IN a conversation with a prominent oyster-packer, says the *Baltimore American*, some curious and interesting features of the oyster trade were related. As is well known, the habits of this bivalve are an entire mystery; what it eats and how it lives are questions not yet understood.

The spawn of the oyster floats around with the action of the waves and tide, and adheres to whatever it may come into contact with. Oysters taken from a rocky bed are of superior quality; those taken from a soft bottom are comparatively poor in quality. Thousands of "poor innocent" oysters die annually from resting on soft bottom, a fact which should arouse the sympathies of all tender-hearted people.

The weight of the oyster, as it gradually matures, sinks it beneath the surface; and as soon as it is covered with sediment or mud, it dies. Many people suppose that the oyster really eats, and kind-hearted people, buying oysters in the shell, sometimes throw corn-meal over them, thinking to feed them. The peculiar noise emanating from them has been supposed to be produced by feeding. All shellfish at times have their shells open, and when touched will instantly close them. The noise thus produced has been mistaken for mastication, when, in reality, it is from fright.

Most of the Baltimore dealers in raw oysters during the summer months transact their business at Fair Haven, Ct., whither large beds of Baltimore oysters have been transplanted. The beds are so arranged that, on the receding of the salt-water tide, fresh water from a small stream covers the oysters; it is said that this fattens oysters better than any other method. Orders are received for the article in question during the summer months, and they are taken from the beds and shipped with the greatest possible dispatch, and many eat them with apparent relish, notwithstanding the warmth of the season. Altogether the oyster-packing trade of Baltimore is an enormous one, and, in connection with the fruit and vegetable packing business, employs a capital of about $25,000,000, a fact which sufficiently expresses the great importance of this interest to Baltimore.

BLUE COLORING MATTER OF FISHES.

POUCHET has been investigating the cause of the blue color of certain fishes, which, as is well known, is extremely brilliant in certain species. In confining his attention to the French species exhibiting this color, he refers the characteristic in question to a constant anatomical cause. Beneath the skin of the portion of the fish so colored there is always a layer, more or less thick, of small ovoid or irregularly circular minute bodies, yellow by transmitted light, which are the product of the complementary blue color in diffused light. These he calls iridescent bodies, from certain analogies with anatomical elements found in the cephalopods and some acephala. The diameter of these iridescent bodies varies from two to four or five thousandths of a millimeter. In the *Callionymus* they are larger than elsewhere, and each is seen to be formed of a pile of extremely delicate lamellæ applied one upon the other, but readily separable under the field of the microscope. This blue color, complementary of the yellow, Pouchet considered to be due to a kind of fluorescence.

NATURAL HISTORY AND ZOOLOGY.

QUALIFICATIONS OF THE NATURALIST.

FEW persons realize the delicacy of touch and steadiness of nerve requisite for the manipulation of the microscope in careful scientific observations, such as those relating to physiological subjects. Professor Agassiz, in his address on the structure and growth of domesticated animals, which appears with the twentieth annual report of the secretary of the Massachusetts Board of Agriculture, said, in speaking of the study of animal organisms: "These objects can not be handled like a piece of wood. They must be treated with a degree of delicacy which makes it impossible, for instance, for an observer to use any stimulant, even such as coffee and tea, or to eat heartily, or to exercise in any degree which may accelerate the pulse; otherwise his eye will be constantly thrown out of focus. Unless a man has himself under control to that extent, he can not begin to make good observations."

ACCIDENTAL COLOR OF BODIES OF WATER.

FROM early ages, the red color of certain natural deposits of water has been a subject of human speculation, and has given rise to the many grotesque fancies of bloody showers, rivers turned to gore, and the similar ghastly imaginations with which ancient legends abound. Homer in his Iliad speaks of a dew of blood which preceded the combat between the Greeks and Trojans; and in the Bible (Exodus, Chapter VII.) it is stated that "blood was seen in all the land of Egypt." Similar natural phenomena appearing in more recent times have engendered superstitious fears among the ignorant, and have been eagerly seized upon by religious fanatics as "signs and wonders" from the heavens, indicative of direct and miraculous celestial intervention.

Modern science, however, teaches that fresh water, thus accidentally tinged, owes its color either to the presence of infusorial animalculæ (*euglena viridis, e. sanguinea, astasia hæmatodes,*) or to microscopic vegetation, (*oscillatoria rubescens, sphæroplea annulina,*) and sometimes even to small insects, *entomostæacæ* (*daphnia pulex, cyclops quadricornis.*) Sea-water, as is well known, also presents hues of varied character. Thus the blue or green tint of the ocean on

the coast of Greenland has been found due to an animalcule resembling the *medusæ*. Of these minute beings, 64 have been found in a cubic inch, 110,392 in a cubic foot, and 23 quadrillions 888 trillions are estimated to exist in a cubic mile. Arago considers that the green bands of water noticeable in the polar regions are due to myriads of *medusæ*, the yellow color of which, in connection with the blue tint of the sea, produces the green appearance. Near Cape Palmas, on the coast of Guinea, the ocean sometimes becomes covered with animalculæ, floating upon the surface, so that it is said that vessels seem to be sailing through milk. Also on the coast of Portugal, the Atlantic for a space of some five miles square has appeared of a dark red, the phenomenon being due to a minute vegetable known as the *protococcus atlanticus*. So infinitesimal are these *algæ* that it is estimated that 40,000 of them would not cover a space of over 0.03 of a square inch. The waters of the Red Sea owe their periodic rubefaction to the presence of a confervoid sea-weed, called *trichodesmium erythræum*. Pallas states that there exists in Russia a salt lake called Malinovoè Ozen, or raspberry lake, because its salt, as well as the liquor left after distilling the same, is red, and has an odor resembling violets.

Dr. N. Joly communicates to *La Nature*, from which journal we extract the accompanying engravings, the following interesting details regarding his investigations into the phenomenon of accidental coloration or rather rubefaction of water in the salt marshes of Villeneuve, a few miles from Montpelier, in France. The liquid is of a strongly marked red color, resembling blood, and a quantity taken from the surface and examined with the microscope showed myriads of little beings. Their bodies were oval and long, sometimes cylindrical. While young, they are colorless, afterward turning green, and finally red. The mouth is in the form of a conical prolongation, and is retractile. No eyes could be recognized, nor could the stomach be distinctly made out. By the aid of powerful lenses, two flagelliform prolongations, extending from the rear of the animalcule, were found, by agitating which it propelled itself in the drop of water on the slide of the instrument.

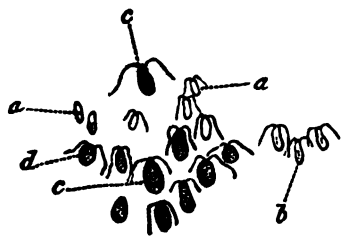


FIG. 1.

The author was led by this discovery to the conclusion that the *protococcus* is an animal and a true monad. On further examining the animalculæ after death, they appear globular in form, and hence the mistake made in determining their nature by previous investigators. A single drop of alcohol, or even of fresh water, in the liquid (on the slide) in which the monads exist, causes them to become motionless and globular, while the same result takes place if they be cut off from access to the atmosphere, as it appears that respiration is absolutely necessary to their existence. Fig. 1 shows the monads (*monas Dunalii*) alive, and magnified 420 times. *a* are the young ones, colorless, *b* are older and of a green color, while those at *c* and *d* are adults, more or less red. Fig. 2 represents the animalculæ after death, in their globular state. It may be noted as an interesting fact that they strongly resemble the *protococcus nivalis*, or microscopic vegetation to which the phenomenon of red or green snow in the arctic regions is due. They seek the light with avidity, always gathering, when confined in vessels, to the brightest side.

FIG. 2.

It has been believed by many savants that the *artemia salina*, a minute crustacean, also aided in giving the water of the salt marshes of the Mediterranean its ruby color. This Dr. Joly does not believe, and he proceeds to demonstrate some curious properties of this strange animal. He states that the *artemia* owes its own color to its consumption of the monads which are taken into its digestive canal. The *artemia* is naturally colorless, and its food, together with crystals of marine salt, shows through its body, thus causing it to appear red. Fig. 3 is a section of its digestive tube, in which *a a* are the monads, not yet digested, and *b* the cubical crystals of sea-salt. The animal itself is represented in Fig. 4, in both its natural size and highly magnified. *o* and *y y* are eyes; *a* and *e* antennæ; *p* is the incubating poc-

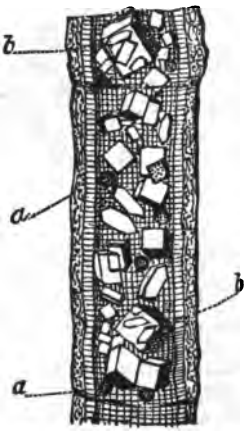


FIG. 3.

ket, showing the eggs within; 1 to 11 are feet, serving both for purposes of respiration and propulsion; *a b* is the abdomen, and *a p* the caudiform appendage; *c* is the diges-

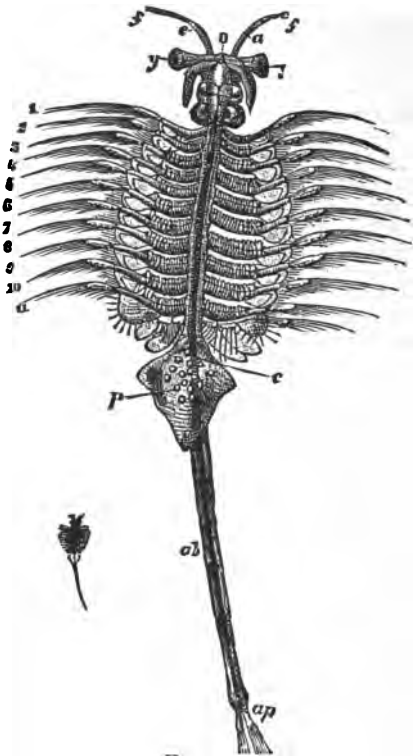


FIG. 4.

tive tube, colored red by the contained monads. It is a curious fact that the young are produced by parthenogenesis, and are always females.

SEVEN THOUSAND LIVING SHELL SPECIMENS.

AN interesting experiment has lately been made in Scotland, under the auspices of the Perthshire Society of Natural Science, in the way of acclimatizing sundry species of land-shells, about seven thousand living specimens of *Helix virgata*, *Helix pisana*, and *Bulimus acutus* having been turned out during the summer of 1872.

THE SHARK AND FRIENDS.

THE shark is always attended by a small blue pilot-fish, which swims about five yards in front of him, and evidently guides him and warns him of danger, his unwieldy size and length making it difficult for him to turn. The pilot-fish appears to do his kindly offices from pure friendship, with no filthy lucre of gain; but he probably benefits in some way by the leavings of his great ally, or the small fry which gather round a dead prey. There is another (strictly speaking) parasite which attends the shark—the sucker-fish, about sixteen inches long, which fastens itself on to him by a curious patch at the back of its head, not unlike the sole of an india-rubber shoe: this adheres with such force that a strong man can hardly drag the fish away when it has thus fastened itself to the deck. Sometimes twelve or fifteen of them may be seen hanging on to one shark. Probably they find it convenient to seek their food, thus traveling, as it were, on their own carriage, free of cost or trouble, and rushing through the water at a rate which their unassisted exertions would certainly never attain.

A SINGULAR FISH.

THE *Rochester Union* describes a curious fish caught three months ago, in Chautauqua Lake, the third of the same sort captured in the lake within the past forty years:

The fish is about six feet in length, and when caught weighed one hundred and thirty-four pounds. There are one back and three belly fins. But the head is what is most wonderful and peculiar about the fish. The mouth opens far back and wide enough to receive a nail-cask. There is a large falling lip or jaw that sets back and upward as the mouth opens. The inside of the mouth is covered with a species of coarse hair somewhat resembling the small feathers or down of an ostrich. Projecting for almost fourteen inches from the upper jaw is a sort of shovel-blade made of a hard substance. This instrument would seem to be intended for throwing food into its mouth rather than for attacking other objects or defending itself against assault. As this fish has no teeth, it is supposed that it subsists upon animalculæ or other substances floating in the water, which are drawn or forced into its mouth by the blade attached to its jaw.

VOICE OF THE WHALE.

SCORESBY and other arctic voyagers and whale-hunters have observed that whales have some means of communication with one another at great distances. It is probable that the animals bellow in a tone too grave for the human ear, but quite within the range of the cetacean ear.

SEA-LIONS AT THE CENTRAL PARK.

A VISITOR to the Central Park happening to be in the neighborhood of the Menagerie about half-past three P.M. would naturally be drawn by the crowd to a large tank containing the two sea-lions. It is their dinner-hour. Some time before the approach of the keeper, the lions are on the *qui vive* and manifest their impatience by repeated barks.

When the food, which consists of different varieties of fish, such as cod, herring, and weak fish, (the cod weighing sometimes as much as four and a half pounds,) is finally brought, they swallow it with a decided gusto, dispensing with the process of mastication. When the meal is finished, they show their satisfaction by dashing about in the water for two or three hours, after which they remain on the platform until the next morning. These sea-lions, *Eumetopias stellere*, were placed on exhibition last April, and are natives of the Pacific Ocean, north of the equator. Their color is of a reddish brown, their hair is straight and coarse, without any growth of under-fur, the nose, palms, soles, and digital flaps naked and black, whiskers cylindrical, long, and whitish, ears short, pointed, and curled, eyes large, iris black, surrounded with a white ring, the fore limbs large and triangular, terminating in a thick membranous flap, and situated almost in the centre of the body. The hind limbs are broad, the width at the toes nearly equaling the length of the foot, toes terminating in strong cartilaginous flaps deeply indented, the three middle ones having well-developed nails, the outer two provided with horny disks or rudimentary nails. The hind feet are always directed forward when the animal is at rest.

Their mode of locomotion on the ground is by raising themselves on their fore limbs and placing the hind limbs forward. The larger of the two lions measures about nine feet in length and five feet in girth. The length of fore flipper is twenty-eight inches; hind flipper, twenty-four inches; weight, about nine hundred pounds. Their bark, which is very peculiar, can be heard distinctly in the night at the distance of nearly a mile. (119)

THE SEA-HORSE.—One of the most interesting events connected with public aquaria has recently been referred to by the press, in connection with the birth of sea-horses *(hippocampus brevirostris)* at the temporary tanks of the Manchester Aquarium Co. It is very doubtful whether such an event ever occurred before in Great Britain, but it is quite certain that it is the first time that the *hippocampus* has been bred in a public aquarium. The Manchester

Company, whose chief building is now in the course of erection, have had for some time a large number of these creatures in temporary tanks in a building erected for the reception of such marine and fresh-water animals as do not require a large space, in order to acclimatize them, and have them ready to remove in a healthy condition to their permanent home in the large building. On the 21st of July, 1873, the curator noticed a young *hippocampus* rise upward through the water and swim about with great activity—vertically, as is the custom of the parent. It hovered about the top of the water, occasionally descending an inch or two, and again soon returning to the top as if for air. The parents, on the contrary, seldom go to the top of the water; with them it is not a necessity. During the day, thirteen other young ones left the pouch of the parent and issued forth into the world on their own account. On the two subsequent days, other young ones followed the example of the thirteen, until the number amounted to about two hundred, for it was impossible to ascertain the exact number.

The young of the *hippocampus* are hatched in a pouch, which is in all cases in the tail of the male parent, the ova being placed there by the female as in a nest. It has been supposed that the young occasionally return to the pouch for protection or rest, but I have not been able to ascertain if that be a fact or not. The young *hippocampi* are about three fourths of an inch in length, and singularly exact in their likeness to their parents: the only noticeable difference is that the eyes are unduly prominent; in every other respect, as also in their mode of swimming and peculiarities of habit, they are the counterparts of their seniors. Perhaps, in these general remarks, I should refer to the greater activity of the young, and their frequent visits to the top of the water. (16)

RATE OF GROWTH IN CORAL.

A SUGGESTION in reference to the growth of coral is quoted by *Nature* from the *Honolulu Gazette* as follows: "Somewhat less than two years ago, a buoy was moored in Kealakekua Bay. Last week the anchor was hoisted in order to examine the condition of the chain. The latter, which is a heavy two-inch cable, was found covered with corals and oyster-shells, some of which were as large as a man's hand. The large corals measured fourteen and a half inches in length, which thus represents their growth during the period of two years that the anchor and cable have been submerged. The specimens which we have seen show the nature of the formation of the coral by the coral animals very distinctly, and give a rate of growth equal to seventeen feet in a century."

THE WATER OF THE DEAD SEA.

IN addition to the long-known buoyancy of the water of the Dead Sea, owing to its saline contents, its other peculiarities are an excessive bitterness, from which the mouth can not readily be freed, and a peculiar greasiness, readily observed upon passing the hand through it. Bathing in it produces an unpleasant itching and prickling over the whole body, even after thorough rubbing, which can only be allayed by a bath in the purer water of the Jordan. Prolonged and frequent contact with the water even causes pustules upon the skin. Its fatal effect upon all organic life is generally known, destroying immediately, as it does, even such animals as have been accustomed to strong salt-water, although fish exist in considerable numbers in its tributaries. This effect is attributed in part to the saline matter contained in it, amounting to as much as twenty-eight per cent, and in part to the quantity of bromine in the water. It was shown by Schneider that small fish were seen in a tributary of the Dead Sea up to a point where the density was 1.115, and it was his impression that chloride of magnesium was the chief cause of the fatal quality of the water. The chemical composition varies with the season, amount of rainfall, etc.; and, according to Terreil, the density upon the surface varied between 1.021 and 1.164, and increased to 1.256 at a depth of 984 feet. Chemical analysis showed that the relative quantities of the ingredients varied with the depth; the percentage of bromine, for example, rising from 0.167 per thousand at the surface to 0.709 per thousand at the depth of 984 feet, an unusual amount, and one that might be of importance in the production of bromine. Iodine and phosphorus seem to be entirely wanting, and the absence of the latter, Lartet insisted, would in part account for the absence of animal life. In failing to discover silver in it, Malaguti afforded additional evidence of a want of connection between this and the seas nearest to it. The conclusion from chemical analysis, as well as a number of geological indications, is that the saline matter in the Dead Sea is due to mineral springs which formerly existed in great numbers in and adjoining its basin, and are still present to a small extent. (92)

POLAR ANIMALS.

THE Hall expedition, in reaching the extreme northern latitude of 82°, the highest ever attained on land, during the month of May sent out hunting parties. Twenty-eight musk cattle were killed, also hares and birds. This is probably the furthest north on our continent that animals have been seen and killed.

HOW TO STUFF BIRDS.

THE first step is to secure the bird. Every one knows how to load a gun with a light charge of fine shot, and shoot a bird at a proper distance, so it may not be blown to pieces at a few paces away from the collector. Therefore, supposing the bird to be already cleanly killed, we will prepare it for the cabinet at once.

When a bird is first shot, a piece of cotton should be put down the throat to prevent the saliva from flowing out of the mouth and soiling the plumage. The larger birds should have their nostrils stopped up by means of cotton crowded tightly into them with some pointed instrument. When reaching home, the bird should be prepared as follows: Lay it on its back, having first broken the wings close to the body. Make a longitudinal cut from the base of the breast-bone (*sternum*) to the vent. Taking hold of the skin with the thumb-nail and forefinger of the left hand, push the flesh from the skin with the scalpel which is held in the right hand. The knife should not be used to cut, unless it be at some part of the skin that is attached to the body of the bird by small tendons, or at the base of the tail, or when severing the legs, wings, and head from the body. As the skin is removed, sprinkle corn-meal or sawdust (meal is preferable) on the flesh exposed, thus absorbing all moisture of the body, and preserving the plumage from becoming bloody. Remove the skin as far as the legs, severing them at the knee-joint, and cutting entirely through the flesh around the bone until the skin is bare between the severed leg and the body. Sever both legs alike, and when that is done, cut off the extremity of the body below the vent, thus removing the skin from the body to which the tail is fastened. Proceed to remove the skin as far as the wings, cut those off where the bone has been broken, and when the wings are freed from the body, continue to skin down to below the eyes.

Great caution is needed in removing the eyelids from the eyes and the ears from the skull without cutting them. The skin is now turned inside out. Cut the body free from the skin, severing the neck close behind the skull. Cut away the under part of the skull, and from the hole thus made remove the brains. Cut the flesh from the leg-bone, and skin the wings from the inside of the skin down to the first joint, (extremity of forearm,) removing all flesh and the broken bone at the second joint, where it is attached to the double bones of the wing; also cut away all superfluous flesh from the base of the tail, and dust the whole fleshy side of the skin with dry arsenic. When this is done, crowd the eye-holes in the skull full of cotton or

tow, and tie the wing-bones nearly together, and return the skin. In no case should the wing-bones be left untied; if so the wings are left free to dangle at their full length, making it almost impossible to put them in their proper place on the bird's sides or back. When the skin has been returned, smooth down the plumage, prick out the eye-holes in their proper shape with the point of a needle or small tweezers. Close the bill together by passing a needle and thread through the nostril and base of lower mandible, and tying them together. Fill the skin out lightly and do not crowd it out of natural size by using too much stuffing. If the bird be a large one, a little cotton or tow should be wound around the leg-bones. When the skin is filled, sew up the open space where the body has been taken out, cross the legs, and tie them loosely together with thread, put the skin into a paper ferule (pinned together) to keep the wings in position, and put it away to dry. When dry, dust the skin with the wing of some bird, and the specimen is ready for the cabinet.

For small birds, cotton is best for stuffing material, but with the larger birds, such as ducks, gulls, hawks, etc., etc., I would recommend sea-grass or excelsior.

An ordinary penknife and tweezers will answer for making small skins, but the following tools will greatly facilitate making skins: one pair dissecting scissors, one pair forceps, one pair small tweezers, and one scalpel. A brain-spoon can be made by flattening one end of a piece of wire, (brass wire is best,) and putting the other end in a handle. (119)

A NEW BIRD OF PARADISE.

SIGNOR LUIGI M. D'ALBERTSO, an Italian naturalist, for some years past engaged in the exploration of New-Guinea, has presented to the British Zoological Society two specimens, a male and a female, of a new bird of paradise, recently discovered by him in that island. He describes the new species as follows: "It is evidently a very rare bird, for many of the natives did not know it, but others called it *quama*. The peculiarity of this bird consists in the formation of the bill (which is very long, and shaped like a reaping-hook) and the softness of the plumage. At first it does not appear to have the beauty usually seen in the birds of this group, but when more closely observed, and under a strong light, the plumage is seen to be both rich and brilliant. The feathers that arise from the base of the bill are of a metallic green and of a reddish copper color; the feathers of the breast, when laid quite smooth, are of a violet gray, but when raised form a semicircle round the body, reflecting a rich golden color.

Other violet-gray feathers arise from the flanks, edged by a rich metallic violet tint; but when the plumage is entirely expanded, the bird appears as if it had formed two semicircles around itself. Above the tail and wings the feathers are yellowish, underneath they are of a darker shade. The head is barely covered with small round feathers, which are rather deficient behind the ears; the shoulders are of a tobacco color, and underneath the throat of a black blending into olive color; the feathers of the breast are violet gray, banded by a line of olive, and those of the vent white. The bill is black, eyes chestnut, and the feet of a dark leaden color. The food of this bird is not yet known, nothing having been found in the stomachs of those I prepared but clear water."

THE BIRDS OF KANSAS.

ACCORDING to Mr. J. A. Allen, of the Museum of Comparative Zoology, Cambridge, in the woodlands of Eastern Kansas there is a decided general tendency to a greater intensity of color than at the northward. The males of the common indigo-bird are more than ordinarily lustrous, and the females also have a decided tinge of blue, which is not the case in the Eastern States; while in Middle Kansas, the light band on the wing of the Baltimore oriole becomes either pure white or scarcely tinged with a pale yellowish color. In the plains proper, the faded aspect of the birds generally struck his attention, especially of species that range across the continent. This abstraction of a dusky or melanistic shade of the birds tends to bring out the pattern much more distinctly, as seen in the representatives in that region of the night-hawk, the meadow-lark, etc.

Most of the species of this region, heretofore supposed to be distinct, Mr. Allen considers as simple races of forms found in the Atlantic States. The difference in color between the Pacific forms of the arid and the comparatively moist regions is greater toward the end of the breeding season, or just before the autumnal moult, than afterward, or in spring specimens, showing the more unmistakably the direct influence of the intensely heated dry winds and strongly reflected light upon the color of birds in semi-desert regions.

Another generalization referred to by Mr. Allen is that birds exhibit a greater tendency to the enlargement of the bill to the southward along the Pacific slope of the continent, just as there is, to perhaps a less extent, in the Atlantic region. As regards color, there is a narrow belt extending from the valley of the Columbia River northward along the Pacific coast where the annual rainfall is nearly dou-

ble that of any other portion of the continent, and in which the birds not only exhibit the brighter colors of the region east of the great plains, but frequently take on a peculiar deep plumbeous or dusky brown, accompanied by a partial obsolescence of spots and streaks, especially in the *Fringillidæ*.

USE OF THE BILL OF THE HUIA BIRD.

A PUZZLING fact in natural history has been the difference in the shape of the bill of the male and female of a certain New-Zealand bird, called the huia, (*Heteralocha acutirostris*,) which in the former sex is lengthened and much curved, while in the latter it is nearly straight. Mr. Buller, however, in a recent work upon New-Zealand ornithology, remarks that the two sexes work together in extracting grubs from rotten wood, the bill of the male being adapted for attacking the more decayed portions of the wood, chiseling out the prey after the manner of some woodpeckers, while the female probes with her long, pliant bill the other cells, where the hardness of the surrounding parts resists the chisel of her mate. Mr. Buller has sometimes observed the male remove the decayed portion without being able to reach the grub, when the female would at once come to his aid and accomplish with her slender bill what he had failed to do. He noticed, however, that the female always appropriated to her own use the morsels thus obtained.

INTELLECT OF BIRDS.

THE intellectual powers of birds are treated of at some length by Mr. Leith Adams, in the London *Popular Science Review*. His facts tend to show that birds surpass all other animals in perception of beauty, social enjoyment, accurate knowledge of distance and direction, and ability to imitate by means of the voice. Not only do many birds arrange their habitations in the most beautiful manner, but we have so high an authority as Mr. Darwin for the statement that they celebrate what appear to be festivities, much resembling human merry-makings, in decorated structures designed solely for such purposes, and not otherwise occupied. Mr. Adams asserts that swifts will return from the south year after year, a distance of at least eighteen hundred miles, not merely to the same region, but to precisely the same nest previously occupied. In power of vocal imitation, tame birds surpass wild birds. The parrot in his native woods does not seem addicted to the repetition of the cries of other creatures. It is mainly in the perceptive faculties that birds appear to excel other animals.

CAN TIGERS CLIMB?

THERE is quite a lively discussion going on in England in regard to the climbing capacities of the tiger, and as to whether he should be shot from a high platform or from a hole. We copy an incident of tiger-shooting given by a correspondent of *Land and Water:*

"The commissioner of the division and an officer of the Royal Engineers were out shooting, and were beating down a nullah, having, as is usual, stationed men forward in the trees to give notice of the brute's whereabouts, should it get on foot. Of these, a Bunjara, who had taken up his position on a branch 18 or 20 feet from the ground, (the exact distance was afterward measured, and was found to be one of the two above numbers,) was the first to see the animal stealing along, and immediately began to wave his turban, and to shout to the line, then about 200 or 250 yards off. The tigress, a small one, stopped, as the native afterward related, looked up, and seeing him, made straight for the bottom of the tree, and began to climb it. Of course the terrified man screamed out, and the line, which had been coming on as fast as possible, being now some 150 yards off, the officer of Engineers caught sight of what was going on, and seeing that the man, who was too paralyzed by fright to try to climb higher, would be sacrificed in another instant, pulled his elephant up and risked a long shot—150 yards measured—and luckily dropped the tigress just in time to save the man. Other instances might be adduced, but I should think the above one ought to satisfy one that tigers can climb. Somewhat in corroboration, however, is the following extract from the *Bengal Sporting Magazine:* 'After relating an anecdote of a tiger who selected a tree to die in, (their resorting to one is not uncommon,) and last year, during the rains, Lieut. Nares, of 53d N. I., shot one who had perched himself in a tree to escape being drowned,' etc. Of course, if any body chooses, he may say these tigers sprang into the trees, and did not climb; but the mere fact of their being so commonly found in them would be strongly in favor of their being able to climb when requisite, even were there no other evidence on the subject."

THE MANATEE.

BY W. A. CONKLIN.—One of the most interesting animals lately received at the Central Park Menagerie is a manatee, believed to be the first of the species ever kept for any length of time in captivity. These creatures are now retreating before the tide of population, and as animals generally are valued in proportion to their scarcity, a brief

description of the manatee may prove interesting to your readers. There are found but three species: *M. latirostris*, inhabiting Florida, the Gulf of Mexico, and the Caribbean Sea coast; *M. australis*, from Caribbean Sea, down the coast of Brazil; and *M. senegalensis*, on the west coast of Africa. The more northern species, strange to say, is more closely allied to the African species, *M. senegalensis*, than to its near neighbor, *M. australis*. Harlan, in his description of the Florida manatee, when he wrote in 1825, says, "that they were found in considerable numbers, so that an Indian was able to capture ten or twelve with the harpoon in one season."

The manatee is generally to be found at the mouths of large rivers, such as the Orinoco and the Amazon, and they ascend the South-American rivers several hundred miles, and even into the inland fresh-water lakes. They are usually seen in small troupes, associating for mutual protection and for defense of their young. When the cubs are captured, the mother becomes careless of her own preservation, and should the mother be the victim, the young will follow her to the shore. Being found in shallow waters, they are easily captured by the natives, who kill them with harpoons, lances, and arrows. The manatees grow to the length of ten or twelve feet, and generally inhabit tropical countries, and are represented in the Pacific or Indian Oceans by the allied species, the dugong. The manatee has the elongated, fish-like body of the whale, head conical, without distinct line of separation from the body. The fleshy nose resembles somewhat that of a cow, semicircular at its upper part where are the nostrils, which are closed with valves when the animal is under water. The upper lips are full and cleft in the middle. Rows of stiff bristles are placed on each side of the cleft. The lower lip is much shorter than the upper one, but the mouth is not very large. In the young animal, there are two sharp incisor teeth in the upper jaw, which afterward fall out; canines none; molars thirty-two; eyes very small; anterior limbs flattened into fins, upon which are four rudimental nails; posterior limbs wanting. The limbs are more free in their motions than those of cetaceans, and can be used for dragging the body about in shallow water; mammæ two, situated on the breast; the tail oval, about one quarter the length of the body, ending in a horizontal rounded expansion. The skin is a grayish dark olive color, becoming black on drying, and has a few scattered bristles on the back. The skin is in great demand by the natives of South-America for making harness, whips, and leathern articles for which great strength is required, and

is noted for its great durability. The oil which is extracted from the fat is of excellent quality. The flesh of this aquatic animal is said to be well flavored, being considered a fish by the Roman Catholic Church, consequently is eaten on fast-days. When properly salted and dried in the sun, the flesh will remain sweet a whole year. Orton, in his *Andes and the Amazon*, says the flesh resembles fresh pork. Captain Henderson, in his account of Honduras, speaks thus enthusiastically of the tail as a titbit: "The tail, which forms the most valuable part of the manatee, after lying some days in pickle prepared for it, with spices, etc., and eaten cold, is a discovery of which Apicius might have been proud, and which the discriminating palate of Elagabulus would have thought justly entitled to the most distinguished reward."

The manatee now on exhibition in the Central Park was received from Mr. P. T. Barnum in the latter part of May, 1873. The following are its absolute dimensions: length, 6 feet 9½ inches; circumference around body, 4 feet 9 inches; length of flipper, 1 foot; width of same, 4¾ inches; width of tail joining body, 1 foot 6¼ inches; greatest width of tail, 1 foot 8½ inches; weight, 450 pounds. It has grown two inches since its arrival. After being received, it was placed in a tank of fresh water, and remained without tasting food for five days, refusing every thing offered to it. A variety of aquatic plants were placed before its mouth, and each in turn rejected. At length some canna, *canna indica*, was procured, which it devoured greedily, and which it continues to use alternately with seaweed, *Fuscus vesiculosis*, obtained in the East River. The process of eating takes place under water, which seems strange in view of the fact that it can not breathe during that time. It manifests at times extreme playfulness, and will answer the call of the keeper by a peculiar noise somewhat resembling the squeak of a mouse. Some time ago the epidermis on the back peeled off in small pieces, leaving a bright new skin similar to that of a snake just after shedding. It was kept out in the open air until the thermometer fell to 53 degrees, when it was removed to a building.

It appears to be very sensitive to the cold, curling up its back if the water is in the least chilly. It has been observed to remain under water five or six minutes at a time without coming to the surface to breathe. (119)

THE Zoological Society of London has been fortunate in rearing the more important animals born there recently, all the four lion cubs and the hippopotamus (Guy Fawkes) born in the course of last year being still alive, though the magnificent mother of the lion cubs died a few months

after their birth. They have still the chimpanzee, (Joe,) which shakes hands with visitors, and performs many other tricks at the word of command. The gardens were probably never in a state of greater efficiency.

THE COCUYO.

THE COCUYO.

THE cocuyo is a variety of firefly which abounds in Cuba and in some countries of South America, and which emits a light much more brilliant than that given off by the small insects common with us during the summer months. Its form and size are well delineated in the engraving herewith presented. At about the end of April, it is found in damp and wooded places throughout Cuba, emerging from its hiding-place at twilight, but rarely pursuing its nocturnal rambles for a greater length of time than two or three hours.

The brilliant radiance of the cocuyo is emitted from its ventral region, where there are three phosphorescent organs which the insect can expose and render luminous at will. It is believed that a substance accumulates slowly in the cells of these members, and is discharged voluntarily. As soon as this principle is set free, it manifests itself by the production of light alone, without heat, and in a manner similar to that caused by the accidental decomposition of tissue, mucus, sugars, etc.

The insect lives in hollow trees and under dense shrubbery, subsisting on young leaves and similar vegetation. At about the end of July it disappears, though it may be kept until September or October. Occasionally, importers of sugar from Havana, in this city, receive specimens of cocuyos from their correspondents, and we have ourselves obtained several in this way. They live for about a fortnight if supplied with brown sugar, though they prefer fresh sugar-cane. By placing a few on a table, in a dark room, a curious and interesting effect is produced by the traveling points of light as the bugs run around the surface. Two or three cocuyos in a bottle will emit sufficient light at night to render a letter easily read or the face of a watch distinguished. They are often thus used by hunters, and Captain Mayne Reid, in one of his interesting juvenile works, makes use of this fact in describing how some surprise party of soldiers, in the Mexican war, managed to read important orders when they had no means of illumination, and, besides, could not have used the same for fear of discovery by the enemy. The cocuyo shows his light best while flying, but it can be forced to shine by dipping it in water for an instant. It is inoffensive to man, but a quarrelsome customer among its own species. When a number are confined, fearful battles ensue, in which the claws form powerful weapons. Mutilation of the members is almost always the result, although the insect often lives for months after severe maiming.

THE HONEY-MAKING ANT.

By Henry Edwards, Californian Academy of Sciences. —The natural history of this very curious species (*Myrmecocystus Mexicanus*, Westwood) is so little known that the preservation of every fact connected with its economy becomes a matter of considerable scientific importance, and the following observations, gleaned from Captain W. B. Fleeson, of this city, who has recently had an opportunity of studying the ants in their native haunts, may, it is hoped, be not without interest.

The community appears to consist of three distinct kinds of ants, probably of two separated genera, whose offices in the general order of the nest would seem to be entirely apart from each other, and who perform the labor allotted to them without the least encroachment upon the duties of their fellows. The larger number of individuals consists of yellow worker ants of two kinds, one of which, of a pale golden yellow color, about one third of an inch in length, acts as nurses and feeders of the honey-making kind, who do not quit the interior of the nest, "their sole purpose being, apparently, to elaborate a kind of honey, which they are said to discharge into prepared receptacles, and which constitutes the food of the entire population. In these honey-seeking workers the abdomen is distended into a large, globose, bladder-like form, about the size of a pea." The third variety of ant is much larger, black in color, and with very formidable mandibles. For the purpose of better understanding the doings of this strange community, we will designate them as follows: 1. Yellow workers; nurse and feeders. 2. Yellow workers; honey-makers. 3. Black workers; guards and purveyors. The site chosen for the nest is usually some sandy soil in the neighborhood of shrubs and flowers, and the space occupied is about from four to five feet square. Unlike the nests of most other ants, however, the surface of the soil is usually undisturbed, and, but for the presence of the insects themselves, presents a very different appearance from the ordinary communities, the ground having been subjected to no disturbance, and not pulverized and rendered loose, as is the case with the majority of species.

The black workers (No. 3) surround the nest as guards or sentinels, and are always in a state of great activity. They form two lines of defence, moving different ways, their march always being along three sides of a square, one column moving from southeast to the southwest corners of the fortification, while the other proceeds in the opposite direction. In most of the nests examined by

Captain Fleeson, the direction of the nest was usually toward the north; the east, west, and northern sides being surrounded by the soldiers, while the southern portion was left open and undefended. In case of any enemy approaching the encampment, a number of the guards leave their station in the line and sally forth to face the intruder, raising themselves upon their hind *tarsi*, and moving their somewhat formidable mandibles to and fro, as if in defiance of their foe.

Spiders, wasps, beetles, and other insects are, if they come too near to the hive, attacked by them in the most merciless manner, and the dead body of the vanquished is speedily removed from the neighborhood of the nest, the conquerors marching back to resume their places in the line of defense, their object in the destruction of other insects being the protection of their encampment, and not the obtaining of food. While one section of the black workers is thus engaged as sentinels, another and still more numerous division will be found busily employed in entering the quadrangle by a diagonal line bearing northeast, and carrying in their mouths flowers and fragments of aromatic leaves which they deposit in the centre of the square. A reference to the accompanying sketch will give a more clear understanding of their course, the dotted line *a* representing the path of this latter section, while the mound of flowers and leaves is marked *c*. If the line *a* be followed in a southwest direction, it will be found to lead to the trees and shrubs upon which another division of the black workers is settled, engaged in biting off petals and leaves, to be collected and conveyed to the nest by their assistants below. On the west side of the encampment is a hole, marked *d*, leading down to the interior of the nest, which is probably chiefly intended for the introduction of air, as, in case of any individuals carrying their loads into it, they immediately emerge and bear them to the common heap, as if conscious of having

been guilty of an error. A smaller hole, near to the south-east corner of the square, is the only other means by which the interior can be reached, and down this aperture, marked *b*, the flowers gathered by the workers are carried along the line *e*, from the heap in the centre of the square, by a number of smaller yellow workers, (No. 1,) who with their weaker frames and less developed mouth organs, seem adapted for the gentler office of nurses for the colony within. It is remarkable that no black ant is ever seen upon the line *e*, and no yellow one ever approaches the line *a*, each keeping his own separate station and following his given line of duty with a steadfastness which is as wonderful as it is admirable. By removing the soil to a depth of about three feet, and tracing the course of the galleries from the entrance *b* and *d*, a small excavation is reached, which is spread in the form of a spider's web, a network of squares spun by the insects, the squares being about one quarter inch across, and the ends of the web fastened firmly to the earth of the sides of the hollow space which forms the bottom of the excavation. In each one of the squares, supported by the web, sits one of the honey-making workers, (No. 2,) apparently in the condition of a prisoner, as it does not appear that these creatures ever quit the nest. Indeed, it would be difficult for them to do so, as their abdomens are so swollen out by the honey which they contain as to render locomotion a task of difficulty, if not to make it utterly impossible.

The workers (No. 1) provide them with a constant supply of flowers and pollen, which, by a process analogous to that of the bee, they convert into honey. The fact that the remainder of the inhabitants feed on the supply thus obtained, though it is surmised, has not been established by actual observation; indeed, with reference to many of the habits of these creatures, we are at present left in total ignorance, it being a reasonable supposition that, in insects so remarkable in many of their habits, other interesting facts are yet to be brought to light respecting them. It would be of great value to learn the specific rank of the black workers, (No. 3,) and to know the sexes of the species forming the community, their season and manner of pairing, and whether the honey-makers are themselves used as food, or if they excrete their saccharine fluid for the benefit of the inhabitants in general, and then proceed to distil more. I regret that at this time I am only able to bring before the notice of the Academy specimens of the honey-makers, (No. 2,) the other members of the community, except from Captain Fleeson's descrip-

tion, being quite unknown to me. It is, however, my hope that, at a future meeting, I may be enabled to exhibit the other varieties, and to give some more extended information upon this interesting subject. The honey is much sought after by the Mexicans, who not only use it as a delicate article of food, but apply it to bruised and swollen limbs, ascribing to it great healing properties. The species is said to be very abundant in the neighborhood of Santa Fé, New-Mexico, in which district the observations of Captain Fleeson were made.

STING OF THE QUEEN-BEE.

AMONG the names of scientific personages who passed from among us during the past year we regret to observe that of Major Munn, a well-known member of the Natural History Society, Kent, England. He was distinguished as an aparian, and made known many valuable facts concerning the habits of bees. At one of the evening meetings he produced upward of a score of lively queens of the honey-bee, and showed how they would fight like game-cocks; and that though these queen-bees did then and there inject the poison of the sting with fatal effect into the spiracles of a rival, they were incapable of stinging even the delicate hand of a lady. This poison-weapon, in short, appeared quite unable to penetrate the skin of man or beast. And the fact, if fact it be, will prove both novel and important, interesting as well in a practical as theoretical point of view. Thus bee-masters and experimental entomologists would be able to handle queen-bees with perfect impunity; and the disciples of the Paley school of teleology may rejoice in the discovery that the weapon of the queen of the honey-bee is a special adaptation or design for a single and special end. Then and there, too, might be seen that happy state of a commonwealth in which the chiefs alone fight it out, alike unable and unwilling to injure their inferiors, and neither asking nor accepting assistance from the valor and property of their subjects.

THE MUSK BEETLE.

OF all the numerous tribe of insects that pass their larval lives in tunneling through our timber trees, and ultimately bringing them to destruction, there is no more active member than the musk beetle (*Cerambyx moschatus.*) And yet, while we deplore the damage which it does, we can not keep our affections from the larva, when it has made its final transformation into the imago state. Its sheeny wings, its graceful antennæ, its marvelous legs, all charm us with their exceeding beauty; in fact, it is not too

much to say, that throughout the ranks of our British coleoptera we shall find no insect which can compare with the musk beetle. Its loveliness is of the true description, and only increases on closer inspection. Viewed under a microscope, its elytra are so wonderfully beautiful that no effort of human art could hope to give even a dull idea of the prismatic coloring. The general tint is a rich green, but there are flecks of azure, bronze, and gold studded on the surface which considerably modify the ground color. Some specimens indeed are almost purely green, but others approach as nearly to golden bronze, and between the two extremes there exists every variety of shade. The size also of the insects differs considerably, the smallest specimens being about half an inch in length. It is impossible to convey any conception of the odor which emanates from its body, and from which it takes its name. This odor, which is very enduring, is often stronger after the death of the beetle than during its life, and may be perceived at a considerable distance from a tree which happens to have one or two "musks" upon its bark. Its favorite resorts are willow-trees, and my own observations lead me to think that it prefers a tree already tenanted by the caterpillar of the goat-moth; but when once its larvæ have commenced their burrows, they wonderfully assist their lepidopterous colleague in the work of destruction. Their tunnels are sufficiently large to admit an ordinary drawing-pencil, and are carried through the trunk in the most fantastic fashion, up and down, backward and forward, round and round, till at last they lead to the surface, where the dull-looking larva turns into the glorious beetle. I have but seldom seen them on the wing. They prefer to crawl about the tree within which they have lived so long, warming themselves in the sunshine and waving their graceful horns. (16)

INTELLIGENCE OF THE TOAD.—At the last meeting of the American Association for the Advancement of Science, held at Portland, Mr. Thomas Hill read a note on the intelligence of toads, giving, among other interesting examples of their sagacity, a description of the means by which the creature contrives to force down inconvenient forms of food. "When our toad," says Mr. Hill, "gets into his mouth part of an insect too large for his tongue to thrust down his throat, (and I have known of their attempting a wounded humming-bird,) he resorts to the nearest stone, and uses it as a *pièce de résistance* in a very literal sense." This can be observed at any time, continues the author, by tying a locust's hind legs together, and throwing it before a small toad.

SILK-GROWING IN ENGLAND.

MUCH interest has lately been awakened in England on the subject of sericulture, and efforts are making to introduce that branch of industry into the country. At the International Exhibition of the present year, a number of silkworm eggs from Orbe, Switzerland, were hatched, and the worms passed successfully through all their transformations. The eggs were hatched on calico, stretched on a shallow wooden frame, hung from the roof. To prevent injury by mice or vermin, a sheet of glass covered the frame, with a small space between for ventilation. The eggs hatched well, and the worms, over six thousand in number, were gathered in tulle nets and placed in the magnanerie. They kept in perfect health, and showed no sign of disease during any of the changes, nor was there any loss of worms, which, considering the variable weather, proves how strong and healthy the breed must be. This hardiness is to be attributed to the open-air system of breeding which is followed at Orbe.

During the second age, about 100 worms were put on a small tree, surrounded by a wire-net cage, so as to test the open-air system in the English climate. But the smut of the London atmosphere soon destroyed them, a result which also followed when some worms in the third age were set out on trees.

Cocooning began July 18, and was all over in about eight days. The worms mounted strongly, and formed their cocoons quickly and well. Most of the cocoons were well made and of good size, some being very large. The quality of the thread is reported excellent, and it reels off with little breakage. The average of the cocoons gives about 1500 yards of silk, and the weight of the entire yield is expected to be one pound and a quarter.

VENOMOUS SPIDERS IN NEW-ZEALAND.

UNTIL recently it was supposed that New-Zealand contained no venomous reptiles or noxious animals of any kind; and it was only so late as the year 1856 that the first scientific notice appeared of a poisonous spider, a native of that country. This notice was communicated to the British Linnæan Society by Dr. Ralph, and contained a brief description of the katipo, (*night-stinger*,) giving an account of its nesting habits and of the potency of its sting. A writer in *The Field*, who has closely studied this animal in its native habitat, cites numerous instances showing that the katipo's bite is occasionally fatal, and invariably very painful. Like many other venomous creatures, the katipo is not aggressive, and stings only when

he is molested and greatly irritated; but, if merely touched with the finger, he will fold up his legs and feign death. If again molested, the animal will try to escape, and will employ his sting only when driven to the wall. The katipo's nest is a perfect sphere, and the eggs about the size of mustard-seed. The changes undergone by this animal in its progress toward maturity are as follows: In the very young state its body is white, with two linear series of connected black spots, and an intermediate line of pale red; under parts brown; legs light brown, with black joints. In the next stage, the fore part of the body is yellow, with two black "eye-spots;" sides black, with transverse marks of yellowish-white; dorsal stripe bright red, commencing higher up than in the adult, and with the edges serrated. At a more advanced age, the stripe on the back is brighter, with a narrow border of yellow, and the thorax and legs are nearly black. In the fully adult condition, the female is very handsome in form and color. The body varies in size from that of a pigeon-shot to that of a small green pea; and the outspread legs even of the largest of these animals cover only a space of three quarters of an inch. The thorax and body are black and shining, with a stripe of bright orange-red down the centre of the body. The male is considerably smaller, having the body blackish-brown, with a faint yellow line down the back.

COLORING OF COCOONS.

A WRITER in a French scientific periodical states that by feeding silk-worms on vine-leaves he has obtained cocoons of a magnificent red, and by feeding them on lettuce, others of a very deep emerald green. Another silk-grower has obtained cocoons of a beautiful yellow, others of a fine green, and others again of violet, by feeding the silk-worms on lettuce or on white nettle. He says that the silk-worms must be fed on mulberry-leaves when young, and supplied with the vine, lettuce, or nettle-leaves, during the last twenty days of the larva stage of their life.

THE PHASMID, OR WALKING-STICK.

ALFRED DOMETT describes several species of that very curious insect, the phasmid, or "walking-stick," met with in New-Zealand, and so called from its singular likeness to withered twigs or sticks. One species has wings like delicate leaves, and another resembles a brilliant green shoot of a plant covered with thorns. They are from three to seven inches long, with slender bodies and legs which they lift high off the ground in walking as if on stilts. Their movements are slow, and they will remain

for a long time motionless in any position in which they are placed, on their backs, and even upright on their two hind legs and tail. Mr. Domett kept a number of these phasmids under a tumbler a fortnight or more, when he found the smallest specimen dead and partly devoured by its companions, and thereupon he killed the rest by placing them in spirits of wine.

THE BREATHING OF FROGS.

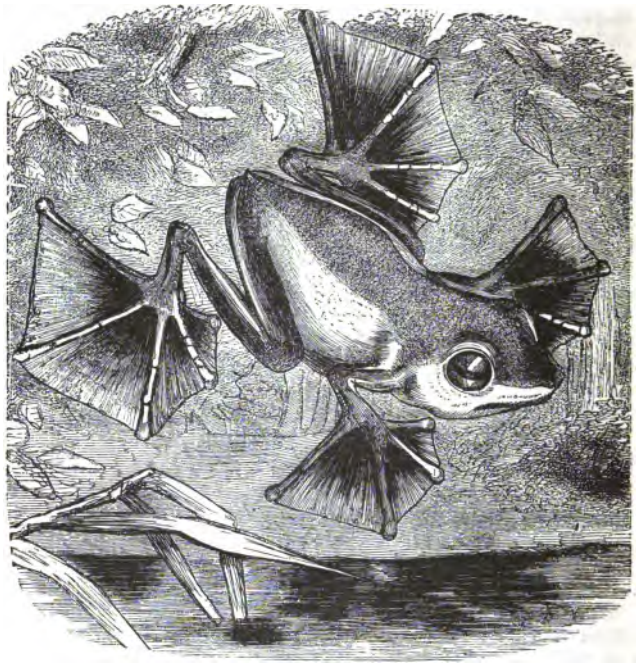
By W. Muller.—The author has compared the amount of oxygen consumed by two species of frogs, the green edible frog, *Rana esculenta*, and the ordinary brown frog, *R. temporaria*, in order to ascertain whether the amount of oxygen consumed by the more voracious species was not the greater. Care was taken, in comparing individuals of the two species, that they should be of about the same age, and that they were caught after a continuance of fine weather. The results obtained were as follows:

1. Single observations often vary greatly, but a series gives results in the same direction.
2. The brown frog consumes more oxygen than the green frog.
3. When hungry, they consume less oxygen, but there is still the same difference between the two species.
4. In winter-time, under water, they consume the same amount of oxygen as when breathing air.
5. Frogs frozen in ice for eight hours breathed at the normal rate after being released.

In order to compare these results with one of the mammalia of about the same weight, the author determined the amount of oxygen consumed by the common mouse, *Mus musculus*, and found it to be more than 24 times as great as that of the frog. (32)

TOADS.

At the first meeting of the Agassiz Natural History Club organized by the students of the Anderson School at Penekese Island, some interesting statements were made about toads. It seems that when these animals are killed by chloroform, the heart continues beating after death, while just the opposite effect occurs in mammals. According to Dr. Wilder, when turtles or toads are killed with benzine, the hearts will continue to beat for several hours, although benzine, like chloroform, always stops the action of the heart in mammals. In reference to the fact that on Penekese the toads are often found secreted during the day-time in holes in the turf at depths of from two to five inches, the same speaker suggested that this might be for the sake of protection from the salt spray which must often sweep over an unwooded island.



THE FLYING TOAD.

ALMOST all frogs and toads pass the first stages of their existence in water, going through a free, tadpole stage, and all are more or less aquatic when adult. The only exceptions are *Pipa*, *Nototrema*, *Opisthodelphys*, and the *Hylodes*. Very many kinds, however, are, when adult, inhabitants of trees. The question may suggest itself to some, "Are there any which can be said in any sense to be aërial animals?" Birds are almost all capable of true flight, as also are those aërial existing beasts the bats, and as were those extinct reptiles the pterodactyles. Certain squirrels and opossums can take flitting jumps by means of an extension of the skin of the flank, and a similar, though much greater extension, supported by elongated freely ending ribs, is found in the little lizards (*Draco*) called flying dragons.

The class of fishes supplies us, also, with an example of aërial locomotion in the well-known flying-fish.

Since, then, every other class of vertebrate animals (beasts, birds, reptiles, and fishes) presents us with more or fewer examples of the aërial species, we might perhaps expect that the frog class would also exhibit some forms fitted for progression through the air. We cannot say with certainty that such is the case; but Mr. Alfred Wallace, in his travels in the Malay Archipelago, encountered in Borneo a tree-frog (*Rhacophorus*) to which he considers the term "flying" may fairly be applied, and of which he says, it "is the first instance known of a flying frog." Of this animal he gives us the following account:

"One of the most curious and interesting creatures which I met with in Borneo was a large tree-frog which was brought me by one of the Chinese workmen. He assured me that he had seen it come down, in a slanting direction, from a high tree as if it flew. On examining it, I found the toes very long and fully webbed to their extremity, so that, when expanded, they offered a surface much larger than the body. The fore-legs were also bordered by a membrane, and the body was capable of considerable inflation. The back and limbs were of a very deep shining green color, the under surface and the inner toes yellow, while the webs were black rayed with yellow. The body was about four inches long, while the webs of each hind foot, when fully expanded, covered a surface of four square inches, and the webs of all the feet together about twelve square inches. As the extremities of the toes have dilated discs for adhesion, showing the creature to be a true tree-frog, it is difficult to imagine that this immense membrane of the toes can be for the purpose of swimming only, and the account of the Chinaman that it flew down from the tree becomes more credible." (47)

REMARKABLE FOSSILS.

IN Colorado, in what is called the Bad Lands, Professor Cope, in his paleontological researches while attached to the Hazain expedition, has come indeed across the graveyard of long-departed creatures. To the labors of Professor Cope we are indebted for the discovery of no less than 100 species, represented by an infinite variety of individuals. From colossal remains of the mastodon down to the bones of the minute rodent, all have been upturned. Even forms of insectiverous animals, as of the Talpidæ, the mole family. The delicacy and minuteness of these smaller fossils and their wonderful preservation make them objects of especial interest. Very certainly they were the forefathers of our squirrels, rabbits, rats, and mice. Of larger quadrupeds, the finds have been quite numerous. Specimens of the

early equine races are demonstrated by the teeth and bones. Colorado, too, in primitive times, must have had the rhinoceros in quantity, no less than seven species having been found by Professor Cope. One representative specimen of the rhinoceros is a skull with teeth. Strange individuals of this remarkable family have been brought to light, notably a horned species, approaching to the elephant. They must have been taller than the present animal, having horns. One of the larger species had a large horn over each eye, and one over the nose. What is remarkable about this discovery is—providing future researches prove these particular remains to have belonged to the rhinoceros family—that it will show a divergence from the usual laws, and that we have been too much inclined to lessen the species development of the ruminating animals. Carnivori abound. There are tiger-cats, dogs, and a new species of the *canis* family, resembling the dog, only as large as a bear. Turtles, lizards, and snakes make up the reptile discoveries. The scientific world is indebted to Professor Cope for no less than 300 species of vetebrated animals, of which fully 150 are entirely new, all the result of his researches in Wyoming, Colorado, Kansas, and Idaho. (119)

REMAINS FROM THE ALEUTIANS.

DR. DALL, of the United States Coast Survey, who had recently returned from an expedition to the Aleutian Islands, gave an interesting description of his explorations of a cave at Unalaska, used as a burial-place by the prehistoric inhabitants. The cave had been partially examined by him last year, and his discoveries reported to the Academy, but on his return he was surprised to find that his search had been quite superficial. Beneath a layer of the slowly accumulating dust of centuries, in which he had previously found curious implements, he came upon a sarcophagus constructed of the bones of the sperm whale, and containing three skeletons in an excellent state of preservation. That these were remains of inhabitants of the islands at a remote period, every indication went to prove. The locations of numerous villages were marked by more luxuriant growths of vegetation, and closer examination discovered the ruins of their dwellings, and large deposits of the bones of fish, which had formed their principal article of food. By excavating in these places, it was determined how the inhabitants had progressed from the rudest condition of savage life, when they subsisted mainly upon shell-fish, readily procured by the employment of little more than mere animal instinct,

until they acquired some degree of skill, enabling them to capture fish, and finally to master the great sperm whale. It was their method to attack the whale with lances pointed with a peculiar kind of stone, supposed to be fatal in its effects upon the huge animal, and after he was slain they awaited the action of the waves to bring him ashore. Dr. Dall declared that the destiny of the Aleutian people was downward, and their history had been that of a steady decline for the last century, and which had been acclerated by the American occupation. He deplored in indignant terms the neglect of the Government, or the Alaska Commercial Company, to provide the people with educational facilities, to the absence of which their decline is attributable.

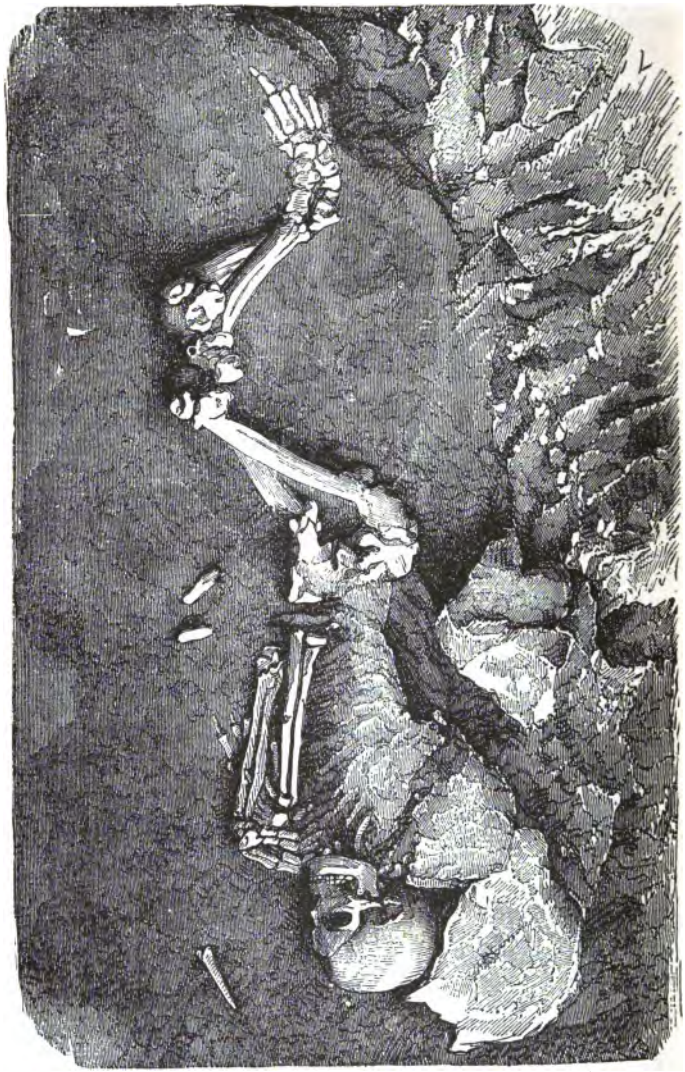
NEW AND REMARKABLE FOSSIL.

PROFESSOR MARSH has discovered in the cretaceous shales of Kansas the skeleton of a fossil bird which is of very great interest in paleontology. In short, it would appear that here we have the long-missing link between fishes and birds. The vertebræ of this bird, which the professor proposes to name *ichthyornis dispar*, are biconcave, like the vertebræ of fishes. The cervical, dorsal, and caudal vertebræ of the animal remain, and in these the ends of the centra resemble those of the reptile called plesiosaurus, while the remainder of the skeleton is of the ordinary bird type.

IMPORTANT ARCHÆOLOGICAL DISCOVERY.

SOME recent discoveries of prehistoric remains in the Cave of Gourdan, Department of Haute-Garonne, France, are worthy of note. The articles found constitute a splendid collection of implements in flint and bone, and also stones and reindeer-horns, carved or sculptured with great care, indicating a higher degree of artistic taste than is exhibited by any other people of the same period. The animals portrayed in this collection are the reindeer, stag, chamois, goat, bison, horse, wolf, boar, monkey, badger, antelope, fishes, birds. There are also representations of some plants. Three drawings of mediocre execution may represent a rhinoceros, a mammoth, and a lion. The drawings are carved in very fine lines, and the artist shows great regard for detail. The carvings from Dordogne are mostly very different from these, being executed with a freer hand.

It is a singular circumstance that in the lowest layer of soil in this cave are found the best representations of animal forms. As the topmost layer is approached, such figures grow more and more rare, the head of the animal



THE FOSSIL MAN OF MENTONE.

now being given instead of the whole body; and, finally, ornamental figures, zigzags, etc., entirely replace animal forms. M. Piette, who recently delivered a discourse before the Paris Anthropological Society on the Gourdan Cave, thinks that this exclusion of animal forms is owing to the progress of religious ideas among the troglodytes.

Several of those curious implements, called by archæologists *bâtons de commandement*, have been found at Gourdan, ornamented with animals' heads. One of them is terminated with a fantastical head, well sculptured. There is also a rib of a horse, with the figure of an antelope carved on it; and the bone of a bird carved with various figures—plants, reindeer, and a fish. This is without exception the largest collection of prehistoric implements in bone and horn ever discovered.

THE FOSSIL MAN OF MENTONE.

THE discovery of a human skeleton in one of the grottos of Mentone, a village on the south coast of France, near Nice, has produced, for some time past, much interesting comment in the scientific world. The cave in which it reposed is hollowed in the garumnian limestone, immediately below the nummulitic tertiary deposit, so well developed in the vicinity. Some large imbedded rocks, probably post-eocene, gave rise to the natural excavation.

It appears from the recent investigations of M. Rivière, that, at the upper portions of the caverns examined, remains of instruments and tools were found belonging to the prehistoric epoch, which immediately preceded, in the west of Europe, the appearance of metals. Below the surface beds, abound remains of human industry, indicating a civilization even more primitive than the antiquity assigned them by the superposed masses. In this locality was discovered, at a depth of 21 feet, the famous human skeleton depicted in our engraving. The earth was evidently in virgin condition, and hence the remains clearly belonged to the geological and palæontological age of its surrounding deposit. While, however, the fauna discovered in connection with the human relics indicate a very ancient palæontological epoch, the bone and stone instruments, and especially the necklace found on the skeleton, seem to point to a more recent period. The presence of cave-bears and hyenas, the *rhinoceros tichorinus*, and *bos primogenius*, evidently relate to the most ancient quarternary epoch, the age of the bear; while, on the other hand, the abundance of remains of deer of various species and of small height, (chamois especially,) the fact of the multiplicity of bone-tools, needles, chisels, and a *baton* of

command, together with the peculiar necklace which closely resembles that found on the fossil man of Cra-Magno, lead to the conclusion that the series of objects belongs to an age posterior to that of the bear—namely, to that of the reindeer. It is believed, however, says Dr. Garrigou, in *La Nature*, that the original owner of the skeleton existed during the latter age, and was buried in a cave formerly inhabited by men of the preceding epoch.

A third skeleton of a troglodyte has just been found by M. Rivière in the grottos of Mentone. This new skeleton seems to belong to a period far more remote than that which has been assigned to the skeleton now in the museum at Paris. The arms and other objects found with the skeleton, which are of flint and bone, do not belong to the polished stone period. They are simply cut, and characterize, by their clumsy form, the far remoter period called "palæozoic." They are rakes, scrapers, punches, arrowheads or lances, blades, etc. On the upper parts of the skeleton have been found large quantities of small perforated shells, having served as a collar or bracelets.

HOW OLD IS MAN?

WITH exceeding accuracy from the lacustrine habitations of man found in Switzerland, the evidences are almost positive that they were built some 5000 to 7000 years ago, and a wide margin for error is allowed. At sixty feet deep in the Nile alluvium, fragments of brick have been found. Calculations of how long it has taken the Nile mud to deposit to such a depth were not difficult. In a century the data were almost positive that $3\frac{1}{3}$ inches represented the thickness of the deposit. Sixty feet then represented a period of 30,000 years, according to M. Rosiere. Agassiz, when studying human remains found in Florida, coming from a lacustrine structure, declared them to be fully 10,000 years old. A human skeleton discovered under four buried forests seems to point to an age of 50,000 years ago.

But these traces of the antiquity of man, whether positive or not, are as if but of yesterday, in comparison with other evidences which are much more definite in character. In Torquay is Kent's Cavern. It is a cavern where stalagmites are constantly forming. The carbonate of lime dissolved in water containing an excess of carbonic acid, dripping through the upper surface of the cave, is deposited as solid carbonate of lime. This simple chemical process, though constant, is a very slow one, a pellicle or film of lime being formed of exceeding thinness. In this particular cave where this process has apparently

been going on forever, names of persons which have been cut two hundred years ago into the stalagmites are still visible, though covered over by a coating or varnish of fresh carbonate of lime. Very careful estimates of how long it would take to form an inch of stalagmite led the British Association to determine that a foot could be only produced in 20,000 years. Now, far below the stalagmite floor, specimens of man's handicraft have been found. At the very lowest estimate, the flint weapons in Kent's Cavern were made half a million of years ago. (119)

FOSSIL ELEPHANT IN ALASKA.

AMONG other collections brought back from Alaska by M. Pinart was a tooth of a fossil elephant which has been reported upon by Mr. A. Gaudry. This specimen is considered to be the sixth upper right molar of *Elephas primigenius* in a state of preservation which will scarcely permit it to be called a fossil. There are certain peculiarities of the teeth, as with the Old World *primigenius* which seem to indicate the fact of a well-marked race, although scarcely worthy of a specific distinction. The most important difference is the greater number of transverse plates—namely, one plate for each centimeter, instead of a decidedly smaller proportion. The enamel is said to be peculiarly thin. The analogy between the European and American mammoth, in Mr. Gaudry's opinion, indicates the probable existence of a communication between the Old and the New World during the first portion of the miocene period, especially as the miocene fossils of France have striking analogies to those of Nebraska, and there are equally well-marked relationships between the plants of Europe and North-America in that same locality.

SIBERIAN MAMMOTH TUSKS.

SEVENTEEN tons of tusks of the Siberian mammoth were recently imported into England from Russia and sold at London. Immense numbers of these tusks are found in Siberia imbedded with the mammoth remains which occur in the earth and ice. In one instance at least, the skin of one of these huge animals was so well preserved as to show that they must have been protected by long coarse hair and a woolly coat underneath it, thus indicating that the climate of Northern Asia was as cold in their ancient epoch as it is now, and that unlike the modern elephant, they were fitted to withstand the rigor of an arctic temperature. There is an apocryphal story to the effect that a party of starved travelers in Siberia once found a buried mammoth in such a state of preservation that they were enabled to use the flesh—perhaps a thousand years old—as food. (120)

THE CHINCHAS ISLANDS.

THE Chinchas Islands are three in number, and lie about 12 miles off the coast of Peru, in latitude 13° 44′ south, and longitude 76° 13′ west, constituting one of the rocky groups which here stud the ocean. In their general physical character, they resemble each other, all being surrounded for the greater part by precipitous, generally inaccessible cliffs, with one or more sandy bays on each island; the latter are, however, in most cases, unapproachable by boats, on account of the surf and the rocks which bar their entrances. Rising gradually up from the edge of the highest cliffs, some in places over 200 feet high, which for the most part are at the eastern end of the islands, are the guano-beds. The deposit covers the greater part of the sea-faces of the islands, but leaving certain headlands completely bare—the bare knolls varying much in their proportionate height and size. On the north island the guano deposits occur as a long ridge, with lateral spurs, its greatest thickness being about 200 feet, and sloping suddenly down toward the sandy bays already mentioned. These hills are all stratified, the strata running horizontally, and varying in their color and size, being from one to about six inches thick, and from a dirty white to a darkish brown in color. In the interior of the hills the guano is dry, and so hard as to require the pick and shovel, while on the surface it is generally loose and friable, being loosest on the sides of the hills nearest the sandy coves; but the strata of one hill appear as though they had once been continuous with those of the others. The underlying rocks of which the original islands are formed are dark red porphyritic granite, overlaid in places by coarse sandstone. On those parts of the island which are bare of guano there is a thin white layer of bird's dung, to be again referred to; and on this island is a small bed of fossilized shell. No plants of any kind, with the exception of patches of *chlorococcus*, grow on the north island; seaweeds are numerous however. In addition to the mules, dogs, cats, pigs, and fowl belonging to the inhabitants, the island swarms with rats, lizards of several species, flies, scorpions, (of which I found the exuviæ of two small specimens under the guano,) *Chelifer fasciatus* (?), and one or two coleoptera. On the sea-rock are land-crabs belonging to the family *Grapsus;* numerous birds, such as the pelican, cormorant, tern, prion, mutton-bird, a little landbird like a grackle, a long red-billed wader like an oyster-opener in its habits and note, Mother Carey, cape pigeon, gannet, diver, and one albatross. Penguins were former-

ly common, but are now rare about the Chinchas, though said to be still abundant at Balistas, one of the neighboring groups. In the circumambient seas, spermaceti whales are occasionally seen, and finbacks, often of great size, are quite common at times among the shipping; but the most numerous and important of all these animals are the sea-lions and seals; though it is difficult to obtain accurate information about them, as shooting is not allowed on the island; but the first seems to be *Otaria leonina*, (Gray's catalogue,) or *Phoca leonina*, (Linnæus.) The sea-lions are still numerous about the islands, in unfrequented parts much more so than in the others, they frequently being upward of 20 feet in length. On the rocks about the north or middle islands they are now seldom seen. but hundreds may be seen basking on those about the south island. In the guano deposit, no organic remains are found, except occasionally birds'-eggs, which are infiltrated with ammonia, in some cases having their shells quite perfect, in others having them crushed in; and these eggs are only found in or near the edge of the hills. Sometimes, especially after heavy dews, the surface of the guano becomes covered with a white crust of ammonia, the subjacent rocks are infiltrated with the same substance, and parts of the cliffs have an inch or more thick incrustation of an ammoniacal salt. The ancient inhabitants from time immemorial used the guano for manure, and for the fining of silver, the substance used for the latter purpose being made up of the seal's dung or *pod*, which accumulates in great quantities during the breeding season on the rocks where the seals suckle their young. (16)

A TREE-VILLAGE AND ITS INHABITANTS.

AMONG the papers presented to Parliament relating to the South Sea Islanders is a report by Captain C. H. Simpson, of Her Majesty's ship Blanche giving an account of his visit last year to the Solomon and other groups of islands in the Pacific Ocean. While at Isabel Island, from which seven women and three men were kidnapped in 1871, Captain Simpson, with a party of officers, went a short distance inland to visit one of the remarkable tree-villages peculiar, he believes, to this island. He found the village built on the summit of a rocky mountain rising almost perpendicular to a height of 800 feet. The party ascended by a native path from the interior, and found the extreme summit a mass of enormous rocks standing up like a castle, among which grow the gigantic trees in the branches of which the houses of the natives are built. The stems of these trees rise perfectly straight and smooth, without a branch, to a height varying from 50 feet to 150

feet. In the one Captain Simpson ascended, the house was just 80 feet from the ground; one close to it was about 120 feet. The only means of approach to these houses is by a ladder made of a creeper, suspended from a post within the house, and which, of course, can be hauled up at will. The houses are most ingeniously built, and are very firm and strong. Each house will contain from ten to twelve natives, and an ample store of stones is kept, which they throw both with slings and with the hand with great force and precision. At the foot of each of these trees is another hut, in which the family usually reside, the tree-house being only resorted to at night and during times of expected danger. In fact, however, they are never safe from surprise, notwithstanding all their precautions, as the great object in life among the people is to get each other's heads. Captain Simpson, in returning, visited a chief's house on the beach, and found a row of twenty-five human heads, captured in a recent raid, fastened up across the front like vermin at a barn-door. It was acknowledged that the object of the raid was to get heads and to eat the bodies, which is always done. The heads of men, women, and children are all taken, and the wonder is that the whole island does not become depopulated. The people of this and other islands are not, however, a courageous people. Such a thing as a stand-up fight between tribes is almost unknown, but they prowl about for prey, attacking whenever they have a victim in their power without risk to themselves. In some of the islands, Captain Simpson observed, the men have long hair, which they wear in fashions like those adopted by the other sex in Europe, the favorite modes being the ordinary chignon, or loose down the back; the women, whose hair is shorter than the men's, wear it loose and undressed. In clothing there is not at present opportunity for European or any other fashions.

CAUSES OF GRAY HAIR.

THE fact that in animals which change to white in winter, especially the hare and weasel, the whiskers and long stiff bristles about the mouth become gray from their tips and not from their mouths, induces Dr. A. L. Adams to believe that cold or some outward agency occasions the change. In his treatise on the natural history of New-Brunswick, lately printed, he mentions the supposition that Europeans become gray more rapidly in the cold regions of America than in England, and that the beauty of the Canadian ladies soon fades; and says that, as to the former, he has himself noticed that men get sooner gray than they would in Central or Southern Europe.

NOVEL HORN EXHIBITION.

CIRCULARS have been issued by Captain Grant, of London, looking forward to an exhibition in that city, on the 1st of May, 1874, of a collection of the skulls and horns of the hollow-horned ruminants, such as oxen, goats, sheep, and antelopes, the object being to bring together as large a collection as possible, with a view of showing the variations in size and structure of each species, and the absolute number in public or private museums. Captain Grant estimates that there are fifteen species of the group known in Europe, thirty-nine in Asia, eighty-nine in Africa, and eight in America, or 150 in all, and it is desired to have from twenty to fifty specimens of each species exhibited.

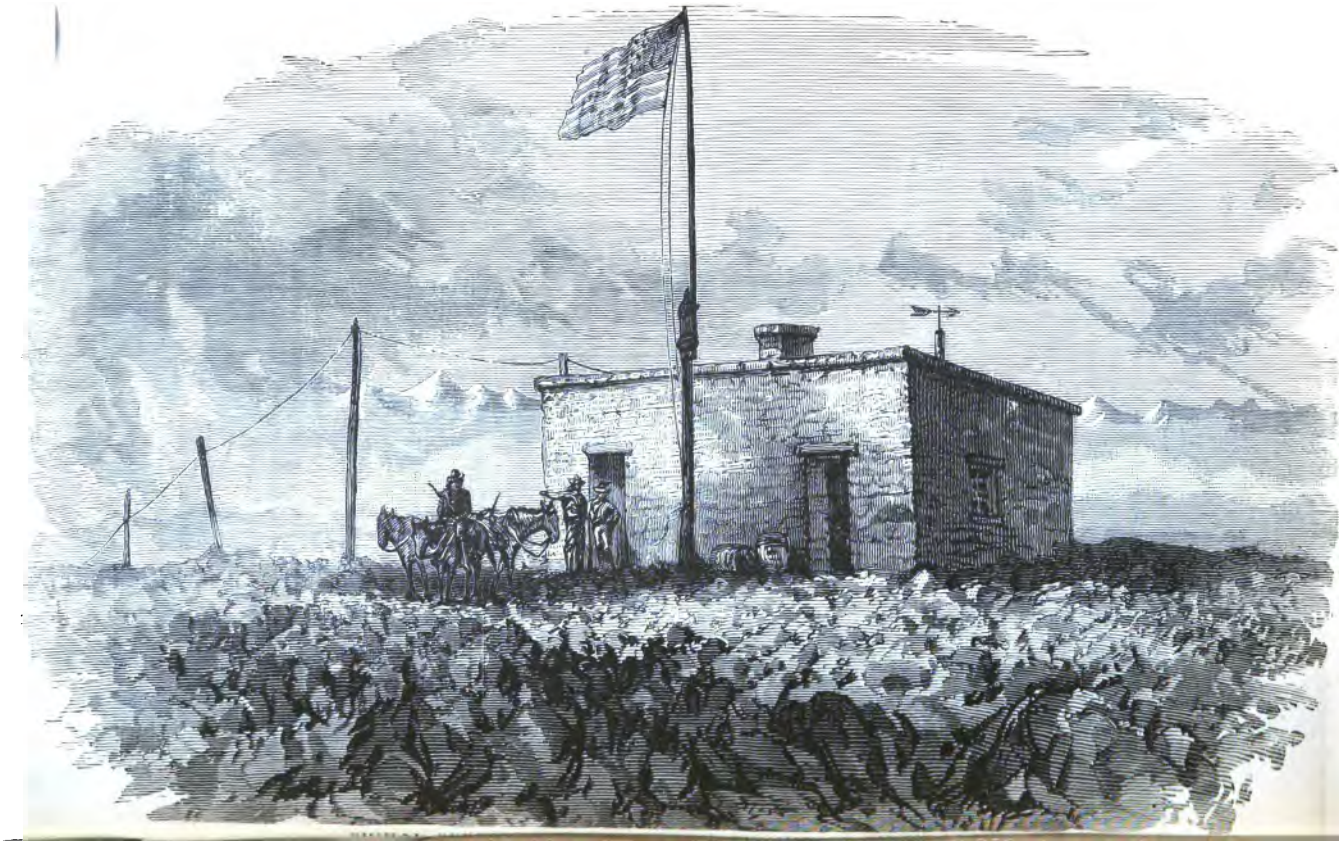
TO PRESERVE FRESH MEAT.

CARBOLIC-ACID paper is now much used for packing fresh meats for the purpose of preserving them against spoiling. The paper is prepared by melting five parts of stearine at a gentle heat, and then stirring in thoroughly two parts of carbolic acid, after which five parts of melted paraffine are added. The whole is to be well stirred together till it cools, after which it is melted and applied with a brush to the paper, in quires, in the same way as in preparing the wax paper so much used in Europe for wrapping various articles.

PTERODACTYL SPECIMEN.

AMONG the recent additions to the Museum of Comparative Zoology at Cambridge is a very complete specimen of pterodactyl, which was believed by Professor Agassiz to be one of the most perfect illustrations of the genus extant. It furnished him the means of correcting some important errors, its special value being in the fact that the two sides are preserved upon corresponding plates, such details as are not appreciable in one plate being evident in the other.

The restorations by Wagler and Goldfuss are proved by this specimen to be imperfect or unnatural; that of the former in regard to the bend of the articulations of the fore-arm, and the omission of the metacarpal joint; that of the latter in the suppression of an entire joint of the hand, the metacarpal part of the whole hand having been overlooked. The number of fingers also appears to have been incorrectly stated, the specimen of Professor Agassiz showing only three short fingers in the hand and four perfect ones in the foot. This is the case, at least, in the type of *P. longirostris*.



METEOROLOGY AND TERRESTRIAL PHYSICS.

PIKE'S PEAK SIGNAL-STATION.

THE United States Signal Service station on the summit of Pike's Peak was formally dedicated on the 11th of October, 1873. It is a substantial one-story building, with walls two feet thick, and was erected at a cost of $2500 The structure faces the east. The ceremonies of the occasion consisted of brief and appropriate addresses, one of which was made by "Grace Greenwood," and the presentation of a large national flag by a young lady of Colorado Springs. Mr. Boehmer, the observer of the station, responded. When the Stars and Stripes were flung to the breeze from the highest signal-station in the world, three rousing cheers were given. A large number of ladies and gentlemen were present, and the party remained at the summit overnight to enjoy from that lofty peak the spectacle of sunrise.

The summit plateau contains about seventy acres of ground, is slightly rounded, and completely covered with huge boulders. A new trail has been opened up the Peak, over which parties can ride to the very top, the ascent being made from the southern side. It is longer, but more gradual and of easier travel, than the old trail. Supplies for the station will be carried up on pack-mules. A military reservation, including the Peak, is now in formation.

Mr. Boehmer, with two associates, Messrs. L. A. Lemman and J. H. Smith, remain at the summit station during the winter for the purpose of taking observations. Messrs. O. H. Sackett and E. W. Boutelle will be stationed at the Colorado Springs office. Our engraving is made from a sketch furnished by Mr. John A. Randolph, of Colorado Springs. (120)

LAND AND SEA-BREEZES.

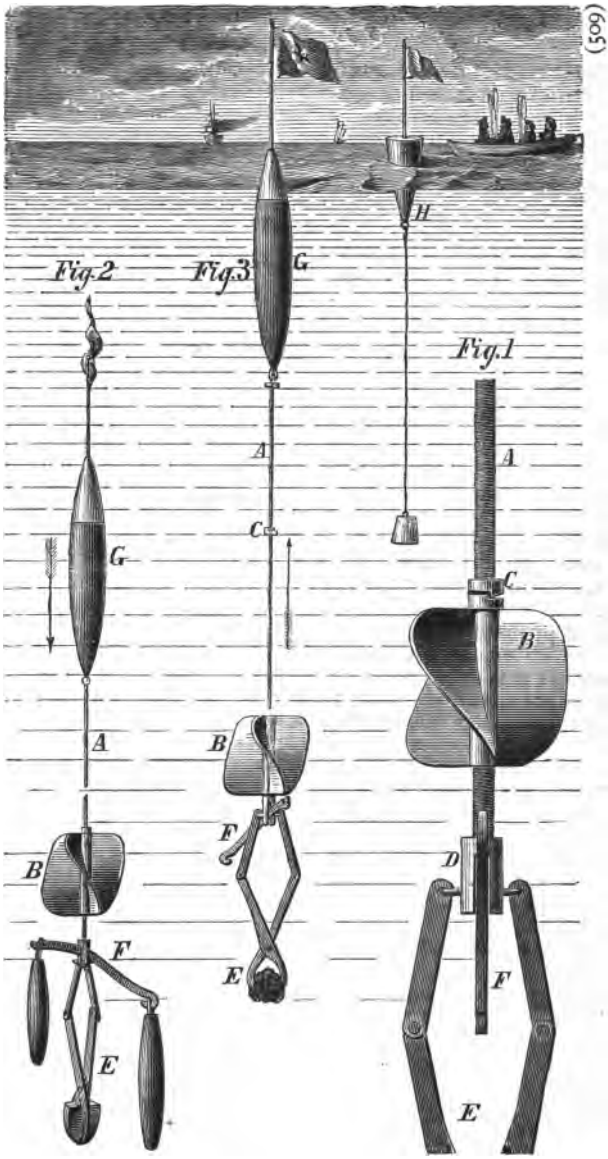
THOSE movements of the atmosphere known as land and sea-breezes, which have a landward direction from morning till evening, and a seaward direction during the night, are usually explained by the rarefaction by heat and the condensation by cold of the strata of air in contact with the land. During the day, it is said, the land becomes more heated than the sea; consequently the air over it ascends, and the cool air from the sea flows in to supply its place. During the night, the temperature of the land becomes, by radiation, lower than that of the sea; the air above it consequently becomes denser and heavier than that over the sea, and, in virtue of the law of diffusion of gases, flows over the sea as a land-breeze.

In a paper read before the London Meteorological

Society, Mr. J. K. Laughton combats this theory, on the ground that it is opposed to observed facts. According to him, the sea and land-breezes are seldom strong where the conditions are more favorable to the heating of the land, and to its rapid cooling by radiation, namely, where the land is arid and without vegetation. On the contrary, they are strong where, from the verdant nature of the country, the differences of temperature are trifling. Further, he says that the sea-breeze commences out at sea, and comes slowly in; and that the land-breeze comes, in the first instance, distinctly off the land, sometimes as sharp squalls.

ORIGIN OF THE ATLANTIC OOZE.

THE saltness of the sea is very rationally accounted for in the following way: A constant distillation of pure water is taking place from the enormous surface of the ocean by the solar heat; clouds are formed, which drift in part over the continents, and on coming into contact with the necessary climatic conditions, fall as rain; this in its turn filters drop by drop through the soil, and forms the springs which overflow and produce the brooks and rivers. The water of the latter, however, is no longer pure, but is found on analysis to contain on an average about 0.7 grains of chlorine per gallon, derived, no doubt, from the soil, and probably in most cases in combination with sodium. The water thus charged with chlorides reaches the sea, where it is subjected to the concentrating process described above, and so time after time the soil is leached, the chlorides dissolved out of it accumulating in the ocean. The same process explains the presence in sea-water of carbonate of lime, which forms a large part of the ooze found covering the bottom of the sea. Chlorides are not the only solid constituents of spring and river waters. For every grain of chloride, such waters contain on an average from six to eight grains of carbonate of lime. This is swept down to the ocean; the carbonic acid in the water, by which alone the carbonate of lime is rendered soluble, is dissipated by the sun's heat at the surface of the sea, and the carbonate of lime subsides in fine particles to the bottom, forming the impalpable mud or ooze described as coating the lower half of the recovered Atlantic cable, This sediment is doubtless partly made up of the chalky exuviæ of marine animal life, but that its bulk is chiefly the product of a process like that above described seems clear, since on any other basis we are unable to account for the disposal of the enormous quantity of carbonate of lime daily carried by rivers into the sea.



NEW INSTRUMENT FOR DEEP-SEA SOUNDING.

NEW INSTRUMENT FOR DEEP-SEA SOUNDING.

THE essential features of this device are a rod or wire A, provided with a screw-thread upon its exterior, and a small propeller-shaped indicator B, which works on this screw-thread. Weights consisting of sand-bags are attached by arm F to the lower end of rod A, and a float G to the upper end. When the instrument is thrown overboard, it sinks to the bottom, and by its descent the indicator B turns, and rises on the screw-thread, carrying upward the stop C. When the weights touch bottom, they are instantly disengaged from the instrument, which is then carried up to the surface by the float G, and by this upward motion the indicator B is made to revolve in the contrary direction. Each turn of B counts for a certain number of feet traversed by the instrument. The position of C indicates the depth from surface of the water to bottom: and the position of the indicator B, when the instrument rises and is drawn from the water, indicates the distance from bottom to surface. Thus we have a double indication made by the same instrument, no sounding-line being used.

It would be difficult to devise a more simple and inexpensive apparatus for deep-sea sounding than this. There is no intricate mechanism, no series of wheels or dials requiring careful adjustment, and not even a line; nothing, in fact, essentially more than a piece of metal wire, screw-threaded from end to end, and a fan working thereon rotated by the motion of the machine. The screw is cut to a certain pitch, so that the descent of the apparatus must be through a fathom of water to cause the fan to make one revolution. The farther the instrument travels down, the higher the fan will climb up the rod. As soon as bottom is reached, and the machine begins its ascent, the fan (of course acted upon in a different direction) runs down the screw, but a messenger on the latter, pushed up by the fan, remains at and indicates the highest limit attained. It is only then necessary to pick up the apparatus when it comes to the surface and observe the distance that the messenger has been carried up, and the depth in fathoms is infallibly told.

Compared with the intricate systems for sounding carried by such vessels as the Challenger, and in other marine exploring expeditions, the present device is a marvel of simplicity and cheapness. It can be made on board, with the tools ordinarily found in the engineer's department of a steamer, or, at most, with one special instrument for cutting the screw-thread upon the wire. The remainder of the apparatus is a block of wood or

other light material for a lifting-buoy, the grapplers which bring up specimens of the bottom, and a watch-buoy. By noting the time of descent, together with the bearing and distance of the watch-buoy H, from the point at which the machine rises to the surface, the bearing will show the difference of direction between surface and submarine currents, and the distance, the velocity. Thus, in the single instrument, is afforded a means of determining depth, character of bottom, and set and rapidity of currents.

The credit of this very ingenious invention is due to Captain Truman Hotchkiss, of Stratford, Ct., a gentleman of large maritime experience.

The instrument may be made of any desired size; and in cases where the grapnel is likely to catch in seaweed or other obstruction, the power of the lifting-buoy can be easily increased to tear away the hold. By means of grapnels E, specimens of the sea-bottom may be readily brought up.

WHAT TO DO IN A THUNDER-STORM.

THE popular notion is that the safest place during a thunder-storm is a feather-bed, and many people, women especially, run to it for security when the thunders roar, and the lightnings flash. Feathers are non-conducting, hence their fancied security. But, according to Mr. Latimer Clark, the eminent electrician, the iron bed is safer than feathers. He says that a person reclining on a sofa or bed at a distance from all the walls of the room could scarcely suffer injury, even in a house struck by lightning; but most absolute security is obtained by lying on an iron or brass bedstead, of the form known as the Arabian bedstead, in which the head is surmounted by an iron erection supporting the curtains. A person lying or sleeping on such a bedstead could not possibly receive any direct injury, even if the house were demolished, and his bedstead forms a most complete lightning-protector.

AN extinct volcano in the island of Niseros, one of the Sporades, Grecian Archipelago, resumed its activity during the month of June. About the 10th, new craters were opened, from which were emitted ashes, stones, and lava, which covered the ground to a considerable extent. Numerous crevices were formed in the sides of the mountain, from which hot water flowed. Earthquake shocks were of daily occurrence, causing the greatest alarm to the inhabitants. The shocks did not extend to the surrounding islands, but the smoke from the craters was plainly seen from Rhodes, which is fifty miles distant.

SIR SAMUEL AND LADY BAKER.

GEOGRAPHY.

THE UPPER NILE REGIONS.

AMONG recent occurrences of geographical interest was the meeting of the Royal Geographical Society, London, when Sir Samuel Baker, lately returned from his great African expedition, gave an account of the regions he had visited and the results accomplished. Sir Samuel Baker, it will be remembered, was the discoverer, in 1864, of the great interior African lake and source of the Nile River, the lake Albert N'Yanza. The expedition, from which he has lately returned, was undertaken in the service of the Viceroy of Egypt, at the head of a military force, the object being to drive out the slave-traders in the upper region of the Nile, and open that rich and splendid country to the arts of civilization and modern progress. Sir Samuel was received with great enthusiasm by the Society.

Sir Bartle Frere took the chair, and said that those present might feel in the position of our ancestors when one of their fellow-Englishmen, like the old sea kings or Crusaders, returned to tell of regions which had hitherto been unknown to them.

Sir Samuel Baker stated that, after a protracted absence, he had returned to the Society with an increase of pleasure and also of regret—of pleasure in seeing around him so many faces of friends, and of regret at missing many of those faces which he had remembered—one of the most dear being that of the father of the Society, Sir Roderick Murchison.

In those countries beyond the regions of the Upper Nile, there were between 10,000 and 15,000 slavers, miserable outcasts from society, and those men, instead of cultivating their country, avoided the necessity of labor by kidnapping men, women, and children in the interior. The Viceroy, having heard of this crying evil, had determined to put it down; but the question was how to stop this traffic which had existed from time immemorial. The Viceroy found a great empire in his land in which was existing this slave trade, which he was determined to suppress, and the first requisite necessary for the suppression was a military force. Sir Samuel Baker accordingly went forth. On arriving at Khartoom, he found that his officers had fraternized with the slave-hunting parties, and the expedition proved then a failure. He having commenced the expedition with 800 men, found a great and terrible

THE ALBERT NYANZA DURING A STORM.

change had come over the Nile—instead of the grand stretch of river, there was nothing but an immense marsh, which was neither land nor water. The slave-hunters had cut through with immense difficulty; but he found, on arriving there, that it was perfectly impossible to cut a way for himself in time to avoid the rains, and having lost 100 men, he found it was absolutely necessary to return. He retraced his steps only so far as the mouth of the Sobat, coming in conflict there with one of the stations of the slave-hunters, and after an encounter with them, releasing a great number of the slaves. The following year he started again with an increased force of 1200 men, and succeeded in cutting a canal through the marsh and tangled vegetation, and putting a small steamer upon it. By these means, he dragged the whole of his force through until he struck the clear Nile. As he marched on, he found that this beautiful country, like many others he had formerly known in a flourishing, happy state, had been devastated by the rascally slavers; there were whole tracts of country where the women had been carried off, and, in fact, he might say, the whole population gone. The only thing to be done was to give the slavers notice to quit the country, and promise the protection of the government to the people, although it seemed a difficult matter, 600 of his men having returned to Khartoom, leaving him with only 500 men at Gondokoro to carry out the Viceroy's instructions, to annex Central Africa and suppress the slave trade. However, he proceeded to Lusinde, where he found a population of 8000 men, all bachelors, apparently, there being no women —a bad sign among the natives. The line of march lay through tracts of land on which the grass grew nine feet or ten feet high; it was the rainy season, and there were 93 miles to cut through; there were just enough provisions to last the men four or five days. The march was conducted in perfect silence in single file, the path being not more than six or eight inches wide. There might be 20,000 men lying around in ambush, and the traveler not aware of a single soul being in the country. The first intimation of their presence will be a shrill, peculiar whistle, in imitation of the cry of a bird, and then thank goodness for the Sniders! The troops had to open fire right and left, and in this way they fought for seven days, losing very few men, fortunately, but having thirty wounded. He then described an interesting ceremony by which he attached the King Mayonda to his interest—that is, exchanging blood, each making a slight incision in the other's arm, and mutually sucking the wounds. The

whole country was now in a state of the most perfect order, for no tribe could make war without the permission of the government; there was nothing but peace and good-will in the whole of the great territory; his trials were over, and he had nothing to do but to thank God for the success which had been extended to the enterprise.

Throughout all his African wanderings, Sir Samuel was accompanied by his devoted wife, who seems to have been at all times the brave supporter as well as the guardian angel of the great explorer. She is a Hungarian lady, of much strength of character, endurance, and every other virtue fit for an explorer's wife. We give an engraving of these remarkable people.

We also give a view of the Albert N'Yanza, and subjoin a short account of the circumstances attending the first view of the lake as given by Sir Samuel himself:

"*The 14th March*, 1864.—The sun had not risen when I was spurring my ox after the guide, who, having been promised a double handful of beads on arrival at the lake, had caught the enthusiasm of the moment. The day broke beautifully clear, and having crossed a deep valley between the hills, we toiled up the opposite slope. I hurried to the summit. The glory of our prize burst suddenly upon me! There, like a sea of quicksilver, lay far beneath the grand expanse of water—a boundless sea horizon on the south and southwest, glittering in the noonday sun; and on the west, at fifty or sixty miles distance, blue mountains rose from the bosom of the lake to a height of about 7000 feet above its level.

"It is impossible to describe the triumph of that moment; here was the reward for all our labor—for the years of tenacity with which we had toiled through Africa. England had won the sources of the Nile! Long before I reached this spot, I had arranged to give three cheers with all our men in English style in honor of the discovery, but now that I looked down upon the great inland sea lying nestled in the very heart of Africa, and thought how vainly mankind had sought these sources throughout so many ages, and reflected that I had been the humble instrument permitted to unravel this portion of the great mystery, when so many greater than I had failed, I felt too serious to vent my feelings in vain cheers for victory, and I sincerely thanked God for having guided and supported us through all dangers to the good end. I was about 1500 feet above the lake, and I looked down from the steep granite cliff upon those welcome waters—upon that vast reservoir which nourished Egypt and brought

fertility where all was wilderness—upon that great source so long hidden from mankind, that source of bounty and of blessings to millions of human beings; and, as one of the greatest objects in nature, I determined to honor it with a great name. As an imperishable memorial of one loved and mourned by our gracious Queen, and deplored by every Englishman, I called this great lake the 'Albert N'Yanza.' The Victoria and the Albert Lakes are the two sources of the Nile."

AN ASCENT OF MT. SHASTA.

By Thomas Magee.—In the northern part of California, unfrequented by the ubiquitous tourist, and as yet scarcely touched by the pen of the versatile Bohemian, lies a region which, in the grandeur and variety of its mountain scenery, is suggestive of the marvelous glacial districts of the Alps. Around its base, magnificently watered and wooded, lies one of the finest hunting and pasture grounds of the continent; while rising up to a height of 14,443 feet is one of the most remarkable regions of volcanic desolation now in existence.

The ride toward the top of the mountain is very beautiful, especially in the late evening of the year. The leaves of the aspen, willow, mountain mahogany and balm of Gilead have lost their vivid green, so remarkable earlier in the summer, and it has been succeeded by a rich delicate orange, a blended green and yellow, or an apple-red. These exquisite hues, mingled with the heather green of the pines, the bright glazed green of the cedar, and the green tinted white of the silver firs, give an attractive variety and a beautiful contrast of colors rarely seen elsewhere.

On all sides of Mount Shasta, the woods are full of different species of bear and deer, and the more elevated portions are frequented by a kind of wild mountain sheep, which in its size, habits, and general appearance, strongly resembles the chamois of the Alps. These sheep are so remarkably swift, timorous, and keen of scent, that the best shots of that region find it almost impossible to get within range of them. The last of the few streams running down the sides of Shasta is found at an elevation of 11,500 feet and is the limit of vegetation. Thus far the trail up the mountain is perfectly safe and practicable for horses, but from here upward the shaded portions of the mountain are perpetually covered with snow and ice. The surface generally is composed of loose volcanic trachyte and dark-red, mud-like, ragged clumps of lava, through which the melted snow percolates and sink to subterrane-

MT. SHASTA AND MUD CREEK CAÑON FROM THE EAST.

an outlets. The desolation is occasionally relieved by the dwarfed *pinus flexilus*, which finds a difficult existence at this height. The half-prostrate attitude of this tree—which never grows upright on account of the weight of snows

and the fierceness of the storms—suggests the fancy that it is craving its existence of the furious elements. These small trees are dead, and yet their branches do not whiten or decay as in less elevated locations. Frost and cold may kill them, but frost and cold embalm them in a never-decaying death. In size this tree is very insignificant, but as fuel it fully maintains the inflammable reputation of the pine family, burning very fiercely and with great purity of light. We gathered several armfuls of this wood at our camping-ground—a labor very exhausting to muscles and lungs, on account of the greatness of the elevation and the rarity of the atmosphere, although the fuel was not far away. Armed with alpenstocks, and disencumbered of all extra baggage, even to purse and watch, we began the ascent. The loose slabs of volcanic trachyte, confusedly piled upon one another, generally afforded a good foothold, When one of these slipped, it made a noise resembling the violent disturbance of masses of broken pottery. On our way up, we passed several extensive fields of frozen snow, which we carefully avoided, the footing on the volcanic débris, treacherous though it sometimes was, being much preferable.

After six hours' weary climbing, during the last hour of which the inclination was about 45°, we reach the crater summit. The mountain here is rounded in shape, and the line of vision therefore only a few feet distant. Nothing intervened between it and Shasta valley, 13,000 feet below. This created the belief that by going a few feet to one side, a sheer precipice of this depth would be found. Though the mind knew this to be an illusion, the eye was constantly returning to the view that created it—that which we dread having in such cases so unnatural an attraction.

In the ascent to the summit overlooking the great crater, we passed over an ice-field which by the continued action of frost had become as hard as flint glass and exceedingly slippery. It possessed the peculiar tinge of blue found in the ice of which glaciers are composed, and like them had been formed by the melting of snow. A sharp thrust with the spike of the alpenstock hardly made an impression in this ice, upon which it was almost impossible to walk.

After crossing the ice-field, we reached the crater rim of the once great but now extinct volcano. The crater is now filled with volcanic débris covered by layers of snow and ice. The present bottom of the crater is apparently 800 or 1000 feet below the rim, which has a circumference of nearly three miles, and is irregularly broken on all sides except the east. The desolation and silence of the

region is made more forbidding by the absence of every vestige of plant life, and by the sombre colors of the mountain sides to the south.

The view from the summit when the sun has dispelled the clouds extends from Pitt River on the northeast to Mount Tamalpais near the Bay of San Francisco on the southwest—a distance of some 500 miles. The great boundary-wall of the Sierra Nevadas lies to the east, and the sinuous outline of the Coast Range to the west, beyond which, and visible over it, the broad Pacific shelves away to the horizon. Between these ranges lies the vast garden of Sacramento. There is no feature which rugged, towering mountains, beautiful, fertile valleys, rich, variegated foliage, wood and water, clouds and clearness, can bring as factors of the grand in nature, that is not found somewhere in the sweep of the vision along this marvelous panorama.

On the summit of Shasta, a number of hot springs are found, which emit a disagreeable odor and have the power of brazing any metallic article which is thrown into them. The chief constituents of the water are sulphur, arsenic, soda, and iron, and the springs are faintly suggestive vents of the region of subterranean fire which once threw its molten lava and débris over the whole of the surrounding country.

On the shaded side of the mountain lies the Whitney Glacier. True only to its nature of protean changeableness, assuming every hue and aspect as the melting portions below are replenished by snow and ice from above, a description of it at morning would not convey a correct idea of its appearance either at noon or at night. It is in the height of its gorgeousness at sunset ; the glow which covered the crater's sides when the volcano was in action is faintly revived ; night and gloom covered every thing below, while the crimson flame of the sunlight pierces the heart of the glacier and is reflected upon all around. It is the sun's last good-night to the continent —the final "red-fire scene" of the day's spectacular drama.

Eight miles below Sisson's are Fry's Soda Springs, where we stopped on our return. The water of these springs, in which iron and soda predominate, is highly charged with carbonic acid gas, effervesces strongly, and is pleasing to the taste.

The height of Mt. Shasta is only surpassed by that of one other elevation in the State, Mount Whitney, which, as Clarence King, of the U. S. Survey, asserts, is the summit of the republic.

Twenty years from now, when the population of this valley shall have become as cosmopolitan as its scenery, and when the facilities for access from "the States" shall have been largely multiplied, those who are longing for the sublimity of Nature, the solace of her communion, and perhaps a touch of her majestic wildness, will turn glad eyes toward Mount Shasta as one of Nature's noblest altars at the gate of one of God's divinest temples.

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TRAVELS IN EQUATORIAL AFRICA.

AT a recent meeting of the French Geographical Society, a missionary named Horner, who has lived twenty years in Zanzibar, gave the members a very entertaining account of his travels in eastern equatorial Africa. In 1870, he made a journey into the then unexplored countries of Kwere and Oukami. After ascending the river Kingani for four days, he struck out in a southeast direction, traveling through a country (Kwere) wasted by continual wars, and having a population of about fifty thousand souls. Here the villages are all in the depths of the forest, and the people live by the chase of gazelles, antelopes, zebras, and elephants. The appearance of the land is remarkably fine, in fact resembling an English park.

Mount Kongwe, in the Oukami country, our traveler found to be five thousand eight hundred and twelve feet above the level of the ocean. It is covered with forests of gigantic trees and furrowed by running streams. One of the great trees in the side of another mountain called Koya was measured, and found to be one hundred feet high from the ground to the first branches. The Oukami country has about two hundred and fifty thousand inhabitants, with a capital built on a hill that is surrounded by mountains, and which has a population of about one thousand. The natives say that there is ice on the mountains in the neighborhood of the capital. The kingdom of Oukami is of recent foundation, and its first chief still lives, an aged despot. The etiquette of this barbaric court is peculiar. When a subject approaches the royal presence, he lays down his weapons and coughs three times. This salutation the king answers by imitating the ferocious roar of a lion, as long as the power of his royal lungs will allow.

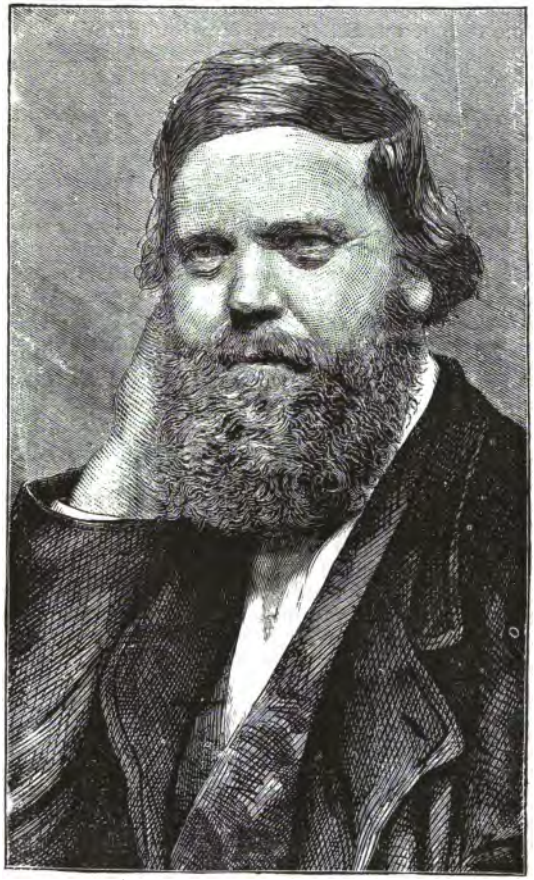
OUTLINES OF MOUNTAINS.

IN an article in *Silliman's Journal*, Professor Joseph Le Conte discusses the causes of the difference in outline as follows: "The great bulge of the earth's crust which constitutes a mountain-chain is doubtless produced by general

causes affecting the whole earth, probably by shrinkage of the interior more than the exterior, by which the face of the old earth becomes wrinkled; but the smaller inequalities are almost always produced entirely by erosion. How any one who has ever been amongst the high Sierras can for a moment doubt this fact, I can not understand. Standing amongst these mountains, all that constitutes scenery, every peak, ridge, or dome, every valley or cañon, is evidently due to this cause alone, except in those parts where recent volcanic action has taken place.

"Now, the forms produced by erosion depend partly upon the kind of rock, and partly upon the kind of erosion. The forms determined by water are different from those determined by ice. Standing in the middle of the San Joaquin plains, on a clear day, the crests of the Sierras are seen on one side and of the coast-range on the other. Nothing can be more striking than the contrast between the two—the sharp saw-like, teeth-like outlines of the former, and the rounded outlines of the latter. The reason is, that the one has been determined by the action of snow and frost—the other by water only. The contrast is still more conspicuous when we are among these summits. In all the region where perpetual snow still lingers, the Sierras are studded with peaks and spires and comb-like ridges —so sharp that they seem ready to fall over, and especially with great amphitheatres bounded on several sides by almost perpendicular palisade-like walls with sharp serrated edges. These great amphitheatres are the wombs of the ancient glaciers and are still filled with snow. Such is the contrast in the summits. On the higher slopes it is equally striking. During the period of the ice-sheet, probably all the Sierra slopes, even to the summits themselves, were covered with rounded forms on a grand scale. Subsequent action of ice and snow and frost and rivers have destroyed these except in some localities. Water tends to form deep V-shaped canyons, while ice produces broad valleys with lakes and meadows. A camping party in the Sierras is made painfully aware of having passed beyond the limits of ancient glaciers by the sudden and entire disappearance of the meadows, and therefore of grazing for horses. I know not how general these distinctions may be, but certainly the coast-range of California is characterized by rounded summits and ridges, and deep V-shaped canyons, while the high Sierras are characterized, on the contrary, by sharp, comb-like summits and broad valleys. And this difference, I am convinced, is due, in part at least, to the action of water on the one hand, and of ice on the other."

ARCTIC EXPLORATIONS—INTERESTING NARRATIVE OF THE HALL EXPEDITION.

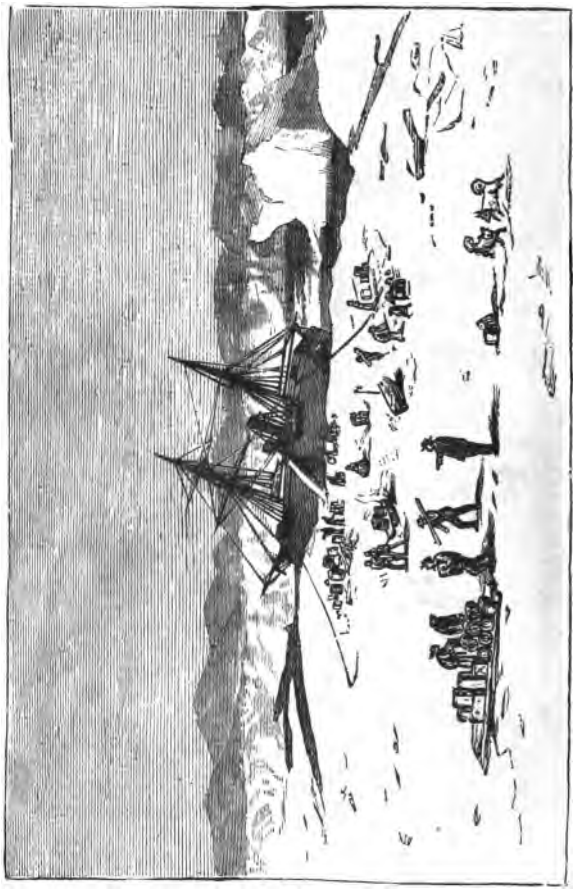


CAPTAIN CHARLES F. HALL.

A STRANGE, eventful history, more like the fiction of the romancer than the recital of plain, unvarnished fact, is the narrative of the last American arctic expedition under the command of the lamented Hall.

The steamer Polaris, it will be remembered, was fitted

out for arctic service in the New-York Navy-Yard, during the summer of 1871, and under the immediate supervision of her commander, Captain Charles F. Hall. Leaving the port, she touched at St. Johns, Newfoundland, and in the

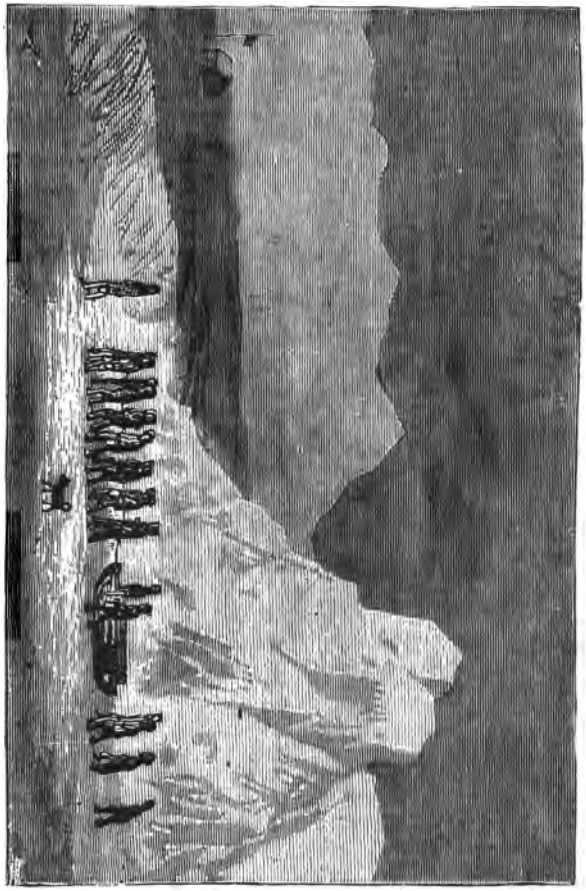


HIGHEST POINT REACHED BY THE POLARIS, ROBESON CHANNEL, LATITUDE 82° 16'.

early part of August met the United States steamer Congress at Disco, Greenland, from which vessel she received her final supplies. On the 24th of August, 1871, after purchasing Esquimaux dogs, skins, and other necessaries,

Captain Hall wrote his adieu to civilization from Tessinsack, Greenland, and sailed for the North Pole.

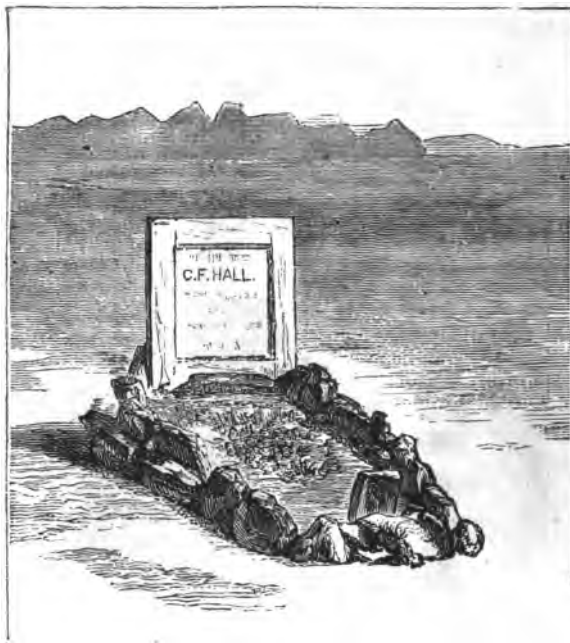
The ship, according to the statement of the survivors, proceeded to the north through Smith's Sound, which is



THE BURIAL OF CAPTAIN HALL, NOVEMBER 10, 1871.

described as identical with the Polar Sea of Kane, discovered in 1853-5, and reached Robeson Channel, in which the highest latitude was attained, 82° 16′. The strait, it was found, extended north for about 45 miles, from 81° 44′ to

82° 20′. Beyond this was a lead of water, and then another ocean or bay, having on its western side land stretching as far as the eye could reach, and on the east another shore but dimly discernible. This expanse was free from ice, and is conjectured to be the north Polar Ocean, or a sound leading directly thereto. Many important circumstances indicated with great clearness that beyond this channel lay an open sea, for mild weather, fogs, and mists could come



THE GRAVE OF CAPTAIN HALL.

from no other source. The vessel came back south a little to Polaris Bay, lat. 81° 38′, long. 61° 44′, where the ship was soon frozen in.

On the 10th of October, 1871, Captain Hall determined to make an individual effort to reach the Polar Sea, and accordingly organized a party consisting of himself, two Esquimaux, and Chester, the mate, the means of transportation being dog-sledges. After an absence of two weeks, on the 24th of October, 1871, the expedition returned to

the ship. Hall, on his arrival, was in good health, but soon complained of the heat of the vessel, was taken sick, and died, November 8th, 1871. He was buried during the dark winter's day by the light of a solitary lantern, in a grave hewn in the ice—sleeping in the midst of the solitude, the secrets of which he had given his life in seeking to reveal.

His surviving comrades passed the winter there, and on the 8th of June, 1872, attempted an expedition northward with two boats, which crossed Kane's Polar Sea, which is stated to be a strait about fourteen miles wide, with an

CAPTAIN S. O. BUDDINGTON.

appearance of open water to the north. Returning to the vessel on the 8th of July, they made preparations to return home.

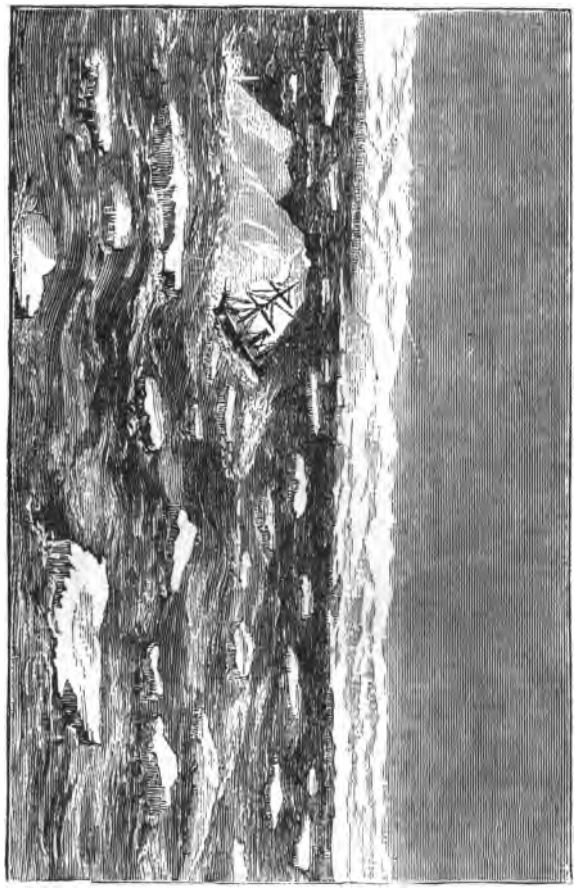
They started homeward on the 12th of August, 1872. On the 15th they were beset with ice, in latitude 80° 2′, and for two months drifted about in the ice, and in October they encountered a heavy southwest gale. The Polaris was under such severe pressure, and was considered in such peril, that on the 15th of October they had commenced landing provisions and boats on the ice, with the probability in view that she would have to be abandoned. While this labor

was still going on, the Polaris broke away from her moorings and drifted away to the south, with a part of the crew on board, leaving nineteen persons on the ice. The party left on the ice, losing sight of the ship, immediately prepared for their own safety. They first attempted to reach the shore, in hopes of finding natives to assist them in living through the winter. But when about half way to land, with their heavily-laden boats, they were compelled by drifting ice to return and haul up on the ice-field again. At this time, Captain Tyson, who was in command of the party, succeeded in saving fourteen cans of pemmican,

W. MORTON, SECOND MATE.

eleven and a half bags of bread, ten dozen one and two pound cans of meat and soup, fourteen hams, one small bag of chocolate weighing twenty pounds, some musk-ox skins, a few blankets, a number of rifles, and abundant ammunition. Knowing that he had not enough provisions, clothing, and other supplies for their probable wants, on the abatement of the gale he endeavored to shoot as many seals as possible, for food, light, fuel, etc., but could only get three, owing to bad weather having set in. On its clearing up, he found himself within about eight miles of what he supposed to be the east coast, and about thirty or

forty miles below the ship. The ice being weak, he could not attempt to transport boats and provisions to land until it grew stronger. A heavy sea was running, which broke

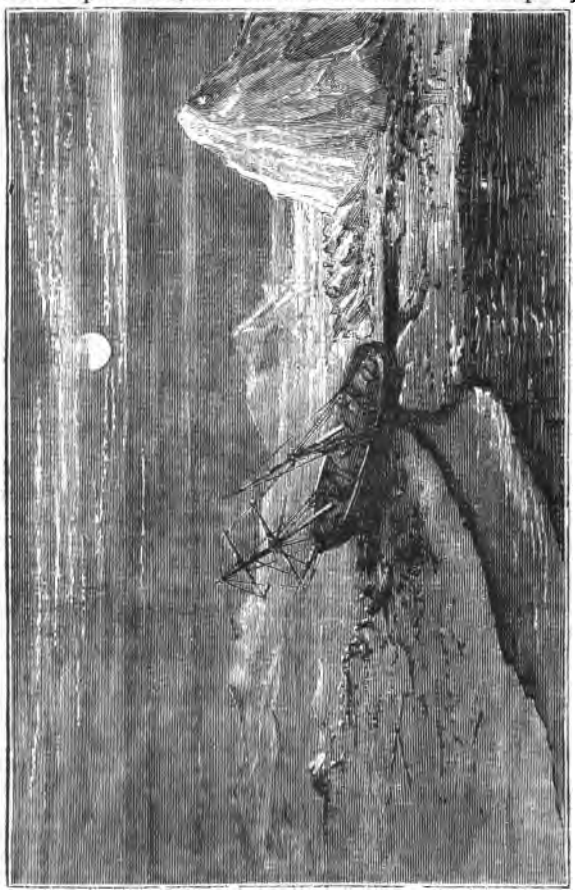


PERILOUS SITUATION OF THE POLARIS, NOVEMBER 21, 1871.

up the ice in places, and separated the party from one of their boats, which was afterward recovered.

The ice gradually increased in firmness, and Captain Tyson made another attempt to reach the shore, carrying every thing in the boats, and dragging them along on their

keels; but the rough and jagged ice stove them in. He succeeded, about the first of November, 1872, in getting about half way to shore; but stormy weather set in again, broke up the ice, and set the floe on which his party was



THE BREAK UP AND SEPARATION, OCTOBER 15, 1872.

encamped adrift to the southward. For many days, they saw no land, the bad weather continuing nearly the whole of November.

The party consisted of ten white men and nine Esquimaux, of whom two were women and five children.

They built snow huts, and made themselves as comfortable as they could under the circumstances. The huts were built in Esquimaux fashion, by piling up blocks of snow on a circular foundation, one layer above the other. The structure has the shape of an old-fashioned bee-hive, and is generally eight feet in diameter and six feet high. Of course they could have no fire in their snow huts, or the snow would melt; and they must have lived all the terrible period without fire, with the exception of the lamps which they must have had for the purpose of cooking, using canvas or rope-yarn for wick, and the fat of the seal for fuel.

In the latter part of February, 1873, still afloat, they lived principally on birds, and in March they began to catch seals. During the whole of that month, they subsisted on the flesh of bears and seals, wasting neither skin nor entrails. Toward the end of the month, they were driven to sea by a strong westerly gale, and their ice-floe, originally about five miles in circumference, was reduced to a mere raft about twenty yards in diameter. They left this precarious support on the 1st of April, abandoning nearly all their stores, and on the 3d gained a landing on a firm portion of the pack. Next day, however, a heavy northeast gale set in, the ice broke into small pieces, and they were once more adrift, as they could not launch their boat. To the other horrors of their situation were added the sufferings of hunger. No seals or bears were to be seen, and their stock of provisions being very much reduced, they nearly died of starvation. On the 21st of April, they sighted a polar bear. The two Esquimaux secreted themselves behind a piece of ice, while the rest of the party lay down and imitated the motions of seals, to entice the bear within gun-shot. Thus a good supply of nutritious food was secured.

A few days after this, they got their boat in the water, and endeavored to work their way to the coast of Labrador, where they hoped to find temporary relief. On the 30th of April, 1873, they were picked up by the British sealing steamer Tigress, Captain Bartlett, in latitude 53° 35′, longitude 55°, near Wolf Island, and about forty miles from the main-land. They were taken to St. Johns, Newfoundland, and were thence brought to Washington by our government. Our government also fitted out an expedition to search for the Polaris and the Buddington party. For this purpose, the rescuing steamer Tigress was purchased and sent to Greenland; but before her return, news was received of the safety of the missing men, who were picked up by a whaler and carried to Dundee, Scotland.

Captain Buddington reports that, after that fearful night which separated him and his vessel from his comrades upon the ice, he never saw them again. It was with difficulty that the Polaris was kept afloat that night, and they momentarily expected she would go down. But they finally reached the shore, where the vessel was beached, and the party wintered in a hut on the land, being supplied with skins and walrus-meat by the natives.

The ship having become entirely worthless, the party employed their time in making themselves comfortable on shore, and in building whale-boats in which to escape southward in the spring. This they did in the latter part of June, 1873, when, in open boats, they sailed southward, encountering many dangers and exposed to the severest hardships. They landed at various points and searched everywhere for cruising whalers. On the 20th of July, 1873, they had the good fortune to fall in with the Ravenscraig, a Scotch whaler, on board of which they were hospitably received, and subsequently conveyed to Dundee, and then home. Thus every member of the expedition was finally rescued, Captain Hall alone having succumbed.

Captain Tyson is known to be a man of much nerve and resolution, and it is probable that the safety of the party under his command was due to his management.

Captain Buddington is a native of New-London, Connecticut. He is now forty-six years old, and has passed his life at sea; five times he has rounded Cape Horn, and three times the Cape of Good Hope. He has made thirteen whaling voyages to Baffin Bay, and he commanded the vessel which carried Hall from New-London on his first arctic voyage.

Captain Tyson states that near Robeson Channel he found many marine fossils, which indicate that the locality was once the bed of the sea. No traces of any permanent habitation of Esquimaux were discovered.

History furnishes no parallel to this wonderful voyage. The escape of the crew of the Hansa, of the German North Polar Expedition, by the same means, is thrown far into the shade. The Hansa was crushed in the ice off Greenland in October, 1869, in lat. 70° 49′, long. 10° 51′, The men, fourteen in number, took to the ice and built a snug house out of patent fuel. They drifted 1100 miles, and, on June 14, 1870, arrived at Fredericksthal, on the other side of Cape Farewell. Their cruise was longer than that of the Polaris party, but they only drifted 10° of latitude, while the latter sailed over 24° 35′, and besides lived in constant peril.

THE SCIENTIFIC RESULTS OF THE HALL ARCTIC EXPEDITION.

DR. AUGUSTUS PETERMANN has lately published an abstract of the general results of the Polaris expedition up to the date of the separation of the rescued crew, as embodied in the report of the Secretary of the Navy, in which he takes occasion to commend in the warmest terms the enterprise of the American government in fitting out the expedition, and of the Secretary of the Navy in taking measures for the relief of the Polaris and her party, and dwells earnestly upon the importance of the scientific results as actually accomplished up to the time when Sergeant Meyer, Captain Tyson, and others went adrift.

Petermann first mentions the amount of depreciation of this expedition, in part due to Dr. Walker, who was disappointed in not accompanying it, and in part to the alleged refusal on the part of the English geographical authorities to recognize the merit of any arctic expedition excepting those instituted and conducted by Great Britain. Whatever the prophecies as to the results, however, Dr. Petermann calls attention to the fact that the Polaris reached a latitude of 82° 16′, and that the party wintered in 81° 38′—the highest latitude previously attained by any other vessel being 81° 42′, by a Swedish ship, on the 19th of September, 1868, to the north of Spitzbergen. In the Greenland Sea region, the highest latitude heretofore reached was 78° 37′, being Kane's winter quarters in Rensselaer Harbor.

He also remarks that the most northern winter quarters of any European vessel was that of the Spitzbergen expedition of 1872-73, in Mossel Bay—namely, 79° 50′—while the American expedition wintered almost two degrees higher. He then makes a comparison between the results of the American exploration and those of the Germania and Hansa, under Captain Koldewey, showing that his highest latitude was only 73° 31′, and that Captain Hall sailed more than seven degrees of latitude farther north; and, moreover, that even at this latitude it was only the unfortunate incapacity or indisposition of Captain Buddington (who succeeded Captain Hall) that prevented the steamer from proceeding even beyond this, as it is quite probable that had Captain Hall lived, he would have made a renewed effort, and doubtless would have reached a still higher point.

It is, however, according to Dr. Petermann, not merely the fact that an increased latitude was attained by Captain Hall's expedition, but also that an important and extended knowledge of the geographical features of the country, as well as its physical and biological characteristics, was

achieved, and the whole is summed up by the assertion that, on the whole, this was in every respect a more important arctic voyage than any from the time of Baffin and Bylot in 1816 to that of Inglefield in 1852. He furthermore remarks that the great Swedish expedition which was fitted out for reaching the North Pole by means of sledges, and which wintered in 1872-73 in the north, did not get beyond one of the Seven Islands, in latitude 80° 45′, finding the ice too thin for their sledges. The result was to involve the necessity of a speedy return of this latter expedition, having accomplished vastly less of its mission than had already been attained by the Polaris.

In regard to the discoveries made by the Polaris expedition along the land, Dr. Petermann remarks that the highest point previously attained by that route was by Hayes, in 81° 35′, on the 18th of May, while the Polaris reached 82° 16′, and from the top of a hill 1700 feet in height it was possible to view the land to a distance still farther to the north—estimated to be up to the eighty-fourth degree of north latitude. Dr. Petermann is of the opinion that the discoveries of the expedition favor the hypothesis of the northward extension of Greenland toward Behring Straits, consisting either of continuous land or of islands. The occurrence of drift-wood on Hall Land, as it is now to be called, he considers likely to prove that the southern fiord is actually continued across to Eastern Greenland, (perhaps connected with Francis Joseph Fiord,) and that through this or some similar channel the drift-wood is carried along. The doctor thinks the land discovered by the German North Polar Expedition in 1867 is almost continuous with that discovered by Hall in 82° 30′.

Dr. Petermann takes occasion to refute the prevailing idea of the dangers and perils of arctic exploration, calling attention to the very few cases of death by disease, starvation, or other calamity in the north, and comparing such explorations and their dangers with those connected with the efforts at African exploration. The commercial promise of the latter country may be greater than that of the former, but, so far as the general interests of science are concerned, we may safely assume that there is much less risk in proceeding toward the pole than in traversing the equatorial regions of Africa.

The article of Dr. Petermann was published under date of July 29, 1873, and is accompanied by a very well-drawn map, which, while reproducing the sketch furnished by Sergeant Meyer, embraces also the discoveries of Kane, Hayes, and other authorities as far south as latitude 76°.

GEOLOGY AND MINERALOGY.

THE DIAMOND MINES OF AFRICA.

As far as one can see within the camp, there is but a succession of pits and mounds mainly occupied by workers busily intent on finding the precious gem. The perseverance and temper of the drifted diggers are shown by the depth of their deserted pits; some are but three or four feet deep, some forty.

At the bottom of the working pits are naked Kaffirs digging and throwing up the earth; others carry it to the *baas*, who, perched high on the upturned soil, is busily engaged in sifting or sorting the gravel.

The claims are limited to thirty feet square, for which a license fee of ten shillings a month is exacted. As there is no opportunity to cast away the upturned earth and surplus gravel—no space being left for roads, and encroachments on neighboring claims being punishable by a fine fixed by the committee—all the earth must be handled on one's own claim. The usual plan is to work out half the claim, piling the sorted gravel on the other, then fill up

SIFTING THE GRAVEL.

the hole, and proceed with the remainder of the claim in the same way.

For sifting the gravel, an apparatus is prepared in this wise: two posts about seven feet long are driven into the ground, four feet apart, and across them ropes are loosely fastened so as to hang in an ample curve. On these ropes are suspended two large sieves of wire or perforated metal. The soil is thrown into the upper and coarser sieve, and the sieves are shaken to and fro. The larger stones stop at the top, the gravel is retained by the finer sieve, the dirt of course passing through to the ground. As the soil is limy and much of it very fine, the dust is terrific, the camp being usually enveloped in a cloud of this irritating eye and lung destroying substance, which is so penetrating that the best hunting watches are clogged up with it in "no time." The editor of the *Diamond News* classes it "with plague, pestilence, and famine, and if there is any thing worse, with that also;" which is somewhat more mildly than the average digger would state his disapprobation of this pest of the diggings.

The sorting is done rapidly; at first sight, it would seem carelessly. When "new chums" begin this branch of the business, they are apt to waste a good deal of time looking at and testing all the pretty stones, especially the clear crystals, which are numerous. After they have once picked up a diamond, however, they find no difficulty in deciding at a glance which are and which are not the objects of their search. Under the bright, clear sky of this region, the diamond is sure to shine out among the worthless gravel in a way that there is no mistaking.

When such a find is made, the shout of joy rings out and loud hurrahs go circling through the camp. Picks and shovels are dropped, the sifter is left at rest, and every dirt-pile is dotted with eager lookers, anxious to see who is the lucky man, all giving the diggings the appearance of a prairie-dog village, or a colony of meerkats perched on their mounds.

This is a "dry digging," the wet diggings being along the now famous Vaal River, where the first discoveries were made. The story of the discovery of diamonds here may be summed up in a few words. The first one was found in the Hope Town Division of Cape Colony, near the Orange River, by the child of a Dutch Boer, or farmer. Ignorant of its value, the children used it as a plaything until one Schalk van Niekerk, a neighboring farmer, saw it, and struck by its lustre and weight, offered to buy it. The child's mother laughed at the idea of selling a stone, and gave it to him. The stone passed through

RIVER-WASHING—CRADLING.

several hands, reaching at last a Dr. Atherstone, of Grahamstown, who on examination pronounced it a veritable diamond. Its weight was 22 carats. Soon after an 8-carat

stone was found in the same division, and more extensive, search was begun. No particular stir or excitement resulted, however, until the famous Star of South Africa became known, in 1869. This rare gem of 83 carats was bought from a native sorcerer by the quasi-discoverer of the first-found diamond. Search for others was increased and with such success that a "rush" set in from all quarters in the early part of 1870, and in a short time the banks of the Vaal, the north branch of the Orange, were covered with busy diggers. The year after, the richer and more extensive dry diggings were discovered in the open, almost desert country between the Vaal and the Orange, and since then new diamond-bearing localities have been found almost daily.

The gem-bearing gravel lies amongst huge basaltic boulders, the removal of which makes the work heavy, slow, and expensive. Besides, the diamonds are scattered with great irregularity and are less numerous, though of slightly better quality than in the dry diggings. The washing-cradles are generally at the river-side, it being cheaper to cart the gravel to the stream than the water to the gravel. After the first rough washing, the gravel is shoveled into the cradle—a strong frame-work carrying sieves and resting on two stout rockers—and the owner "rocks the cradle;" his native helpers pour water over the gravel until it is thoroughly cleaned and sifted. After a hasty glance at the large stones in the upper sieve for a possible big diamond, the contents of the finer sieves are transferred to the sorting-table. If this has legs, the sorter sits at his work; if it rests on the ground, he has to work in reclining posture. This is a pleasanter place for sorting than the dry diggings, owing to the absence of dust; still it has its objections. The sorters suffer severely from cold sometimes, and, at best, sitting with one's feet in wet gravel all day is far from comfortable.

The gravel is spread thinly over the level surface of wood or metal that serves as a table. The sorter detects at a glance any diamond or other stone that he may wish to preserve, then strikes off the rest with a straight-edge of wood or metal, usually a short piece of hoop-iron. Occasionally a valuable ruby or a sapphire is found in these riverside diggings. Some do their washing on their claims, especially when working alone or with a single partner, or when too poor to own a cart and team. The washing is done in a couple of tubs made by sawing a wine-cask in two, and filled with water from the stream. If the earth is tolerably dry, the gravel can be cleaned in part by dry sifting; it is then placed in common hand-sieves and

BULTFONTEIN DIGGINGS—DU TOIT'S PAN IN THE DISTANCE.

twirled in one tub until tolerably free from dirt, and rinsed quite clean in the other. When the tubs become too muddy, they are refilled from the river and the washing goes on. The claims at this place are worked to the depth

of thirty or forty feet, turning the hill-slope upside down and covering it with heaps of quarried stone.

The dry diggings are wide, almost treeless and waterless, plains covered with calcareous soil, which from its dusty nature adds immensely to the miner's discomfort. The earliest finds away from the river were made in 1870, at Du Toit's Pan. At first the claims were worked only two or three feet below the surface; after this surface-earth was worked out, and the diggers were looking about for "pastures new," some one had courage to penetrate the bottom rock, and was rewarded by finding the diamonds more numerous and of larger size as he descended. A rush then set in, and Du Toit's Pan soon became the largest and richest diamond camp in the world; no other place up to this writing has afforded so large a number of stones or so many of large size. Gems of a hundred carats and upward are by no means uncommon. An immense area is being dug over here, and there are rich diggings all around.

Joining Du Toit's Pan is Bultfontein, originally a cattle-farm. Diamonds were found here in 1871. This farm has yielded a very large number of diamonds, none of which, however, have been of considerable size.

Another similar farm called Alexandersfontein joins Bultfontein, making with Du Toit's Pan one large community, with regular streets and other beginnings of a great city. Two miles to the other side of Du Toit's Pan is a picturesque camp known as De-Beers, where many large stones have been found. Workings began here in May, 1871, and in a few months a large population had come together, making quite a town.

Diamonds are found at all depths, and in some claims from the surface down; a fine 10-carat stone has been found at the depth of 96 feet, while sinking a well. Sixty feet is not an uncommon depth for claims to be sunk, and sometimes twenty feet of red sand has to be removed before the diamond-bearing soil is reached. The best diamonds are said to have been found at the depth of twenty-five feet or thereabouts.

It is impossible to estimate the extent of the diamond-bearing country; new fields are being discovered almost daily. The more intelligent people here are of opinion that the surrounding country is as likely to be rich in diamonds as the claims at present worked. A rush has lately been made to a farm on the Orange River, where diamonds of 50, 47½, 11, 10, and 8 carats have already been found, besides numerous smaller ones.

Here, as elsewhere, the capitalist has a great advantage,

DE-BEERS' RICH CLAIMS.

since he can employ numbers of laborers, properly overlooked by trustworthy men, move them from place to place as discoveries are made, and, if he is scientific, bring to his aid all the help that science can lend to the matter, which, however, is not much. The finding of diamonds is

simply fortune, nothing on the surface can tell you where to dig. Muscle and patience are the winning cards. Those who have been the longest here and have had the most experience are no wiser than those who came yesterday as regards the selection of a claim. Success is a question wholly of time and perseverance and good luck, the last being the principal item, since many have worked long and faithfully with little profit, while others have made splendid finds almost with the first stroke of the shovel.

The climate here is by no means the worst, yet it is extremely trying to new-comers, especially to those unused to an exposed life. During the summer months, the thermometer frequently registers 100° Fahr. in the shade, and there is very little shade to be found at the dry diggings. There is almost always a hot wind blowing at this season, with the attendant clouds of acrid dust already described. Thunder-storms occur almost daily, and are frequently preceded by dust-storms of the most violent character.

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GOLD-WASHING IN BRITISH COLUMBIA.

MR. ALFRED SELWYN, of the Geological Survey of Canada, reports that nearly all the Indians on the Fraser River above Fort Yale have become gold-washers. They return to the same point year after year, at the season of lowest water, to wash the sands of the river, and it is asserted can almost always earn for a day's labor from one to two dollars' worth of gold. Besides the Indians, there are quite a number of Chinese who make a living in the same way, and appear to have permanently located themselves at intervals all along the banks of the river, where they are living in log huts, and, often in the most unpromising-looking places, have made small gardens in which they raise fine crops of vegetables, that find a ready sale to the teamsters on the wagon-road. "There seems no reason to doubt," adds Mr. Selwyn, "that the gravel benches or terrace deposits of the Fraser and of the North-Thompson, which border these rivers from Yale to the Leather Pass, as likewise those of many similar valleys in British Columbia, would afford a highly remunerative field for hydraulic gold-washing on a large scale; the only drawback being the unavoidable suspension of operations during the winter.

A NEW SILICO-ALUMINATE OF MANGANESE.

SMALL, tabular, crystalline masses, imbedded in quartz. It has a vitreous or resinous lustre, with a slightly nacreous appearance upon the faces of cleavage, and a resinous fracture. Translucent in thin layers, of a yellow or yellowish-brown color, and very brittle. Hardness = 7. Specific gravity = 3.577.

THE GEYSERS OF CALIFORNIA.

PETRIFIED TREES.

AT the head of Napa Valley stands Mt. St. Helena, the culminating point of the ridges between the Bay of San Francisco and Clear Lake. It is a mass of volcanic rock 4343 feet high; the apparently single point of its cone, like nearly all volcanic peaks, separating into two as it is approached or circled. Most of its bare bulk is visible, rising like an irregular pyramid at the end of the long valley-vista—a grand object far or near, whether in its customary suit of gray or flashing in the splendor of its evening robe; continually shifting its color and form as it is seen close or far, on this side or that; opening its rocky breast at last to nature's softening touch of spring and brook and tree, and drawing up about its awful flanks some of the verdurous beauty of the valley. One of the best views of this mountain, on its southerly side, is that from Calistoga. Calistoga is at the head of Napa Valley, and the mountains here inclose a small circular plain, studded with large oaks and charged with thermal springs that send up little puffs of vapor, filling the air with mineral smells. Soda and sulphur are the principal mineral

constituents of the thermal waters, whose heat rises to the boiling-point. In the hills near by are the remains of a petrified forest, the stony trunks of oak and conifer being quite numerous. When growing anciently, they were buried by an earthquake shock, exposed to a watery solution of volcanic matter, which silicified them, and subsequently elevated again and partly uncovered by the washing away of the enveloping earth.

Mt. St. Helena was once the centre of volcanic disturbance in this region, and threw its ashes and lava over a good part of the surrounding country. The hot springs at many points in the valley and hills, the pumice and obsidian scattered widely over the surface, the masses of volcanic rock observable, all indicate a time when this was a volcanic centre. And these indications extend northward at least as far as Clear Lake, some forty miles distant, where deposits of sulphur and a lake charged richly with borax are found. The earthquakes still occasionally felt through this region are not alarmingly severe. During the past winter a new hot spring burst out of the eastern side of Mount Lincoln, scarcely more than fifty feet above the valley level, and has continued to puff away ever since. Geyser Peak is 3471 feet high, and forms one of the triangulating stations of the United States Coast Survey, being plainly visible from the ocean and from San Francisco. It is a conical peak, like all the dominating points of this range, and commands a magnificent view. Masses of stained and blackened rocks, serpentine, sandstone, and trap, rise here and there, giving the nearing summit a desolate look, which is increased by the few contorted pines that suck a feeble life from the crevices where they grow. A narrow ridge, called the Hog's Back, connects two spurs of the range at this point, separating Sulphur and Pluton Creeks. Pluton Creek, which is a tributary of Russian River, heads up toward Mt. St. Helena, and until it comes within the influence of the Geysers is a charming trout-stream. Its banks and bed are extremely rocky. Huge boulders of granite and sandstone choke its course, and black volcanic masses rise in frowning cliffs by its side, sometimes softened with a drapery of vines, and bearing trees on their creviced tops. Great blocks of conglomerate, apparently formed almost *in situ* by the mineral constituents of the waters percolating through the diluvium, are also seen obstructing the creek. Occasionally it has cut through a bed of this conglomerate, which forms its banks. For all this ruggedness, the creek is very picturesque, and has many spots of gentle beauty where the sun beams athwart quiet pools, and maples and pepper-

trees mix their gentle grace with the sombre foliage of fir and bay and evergreen-oak.

The banks are charged with iron salts for a great distance up and down, and their solutions have given the earth its red tinge, and hardened the gravel-beds into a semi-metallic mass. At the crossing to Geyser Cañon is the whey-like tint of the water in the creek, which for a quarter of a mile or more is affected by the sulphur discharges, some of which bubble up through the very bed of the creek itself. Thermal springs of various sorts are numerous along the creek, especially on its right bank, for several miles; but the most remarkable are those facing the hotel. The prevailing rocks are metamorphic sandstone, silicious slates, and serpentine. Their stratification is boldly exposed, and dips at a sharp angle to the line of the creek. Through the lines of fracture or cleavage, from the water's edge to a height of fifty or a hundred feet up the slope opposite, numerous springs and steam jets escape, coloring the face of the slacking rocks vividly with the yellow, red, and white salts of sulphur, iron, lime, and magnesia that they deposit. The springs are of various temperatures, some of them exceeding 200°. One forms quite a large stream, and is led by troughs into a row of small shanties, where its steam is used for bathing, the bather jumping immediately after into a rocky basin of the creek two or three feet off, the waters of which are most shockingly cool. Where no heated waters flow from the rock the steam issues under a high pressure, intensely hot, and shrieking or hissing. From one hole a foot or two wide, at the base of the bank, it escapes with a noise like that of a high-pressure steamboat "blowing off;" and this vent is appropriately called the Steamboat Geyser. For a hundred yards here the rocks are hot under the feet, and as they are also slippery with moist mineral salts and puffing from numerous small vents, the spectacle they present is in sharp contrast to the sylvan beauty of the creek. Yet grasses grow in these heated rocks, out of the very salts, and one or two thermal plants dare to blossom at the edge and in the very breath of the hottest springs, whose waters are sometimes greened with low forms of microscopic plant-life, which also slime the rock where they overflow.

Following down the right bank of the Pluton for a short distance, the trail turns to the right and enters a gorge densely embowered by shrubs at its mouth, but soon opening into the desolate regions of the Devil's Cañon. The nomenclature, like the scenery, from this point, is all infernal, suggestive of Dante and his awful journey. Climb-

DEVIL'S CAÑON.

ing up a ledge that crosses the cañon, we suddenly gain a view of the principal Geysers. The gorge for half a mile up the side of the mountain lies before us, a steep ascent,

filled with steam and noise, its bare sides painted many colors, its bed obstructed with boulders, around and under which turbid waters gurgle and smoke.

The hot ground under the feet; the subterranean rumblings; the throbs and thuds near some of the largest and most energetic steam-vents; the warmly moist atmosphere, filled with acidulous and sulphurous vapors, sometimes charged with strong odors of sulphureted hydrogen; the screaming, roaring, hissing, gurgling, and bubbling of the various springs—all contribute to make the scene as repellent to some natures as it is grand and exciting to others.

There are no spouting fountains in the cañon, but numerous bubbling springs, that sink and rise with spasmodic action. These number a hundred or two, and are of varying temperature and constituents. A few are quite cold, closely adjoining hot springs; while others have a temperature of 100 to 207 degrees. Some appear to be composed of alum and iron, others of sulphur and magnesia, while a few are strongly acidulous. Here the water is pale yellow, like that of ordinary white-sulphur springs; there it is black as ink. The mingling of these different currents, with the aid of frequent steam injections, intensifies the chemical action, the sputter and fuming, that are incessantly going on. These phenomena are not confined to the narrow bed of the gorge, but extend for a hundred or two feet in places up its sides which slope at a pretty steep angle. These slopes are soft masses of rock decomposed or slacked by chemical action, and colored brilliantly with crystallized sulphur, and sulphates of iron, alum, lime, and magnesia, deposited from the springs and jets of steam, which are highly charged with them. As the rocks decompose and leach under the chemical action to which they are subjected, the soft silicious mass remaining, of a putty-like consistence, mixes with these salts. Some of the heaps thus formed assume conical shapes. They have an apparently firm crust, but are really treacherous stepping-places. One of the most remarkable steam-vents in the cañon is in the top of such a pile, fifty feet up the steep slope. It blows like the escape-pipe of a large engine. The beautiful masses of crystallized sulphur which form about it, as about the innumerable small fumeroles that occur along both banks, tempt one to dare to climb, and face the hot steam. The mass shakes beneath the tread, and is probably soft to a great depth. Wherever in these soft heaps a stick is thrust in, the escaping warm air soon deposits various salts. Perhaps the most remarkable of the Geyser springs is that called, hap-

pily enough, the Witches' Caldron. This is a black cavernous opening in the solid rock, about seven feet across, and of unknown depth, filled with a thick inky liquid, boiling hot, that tumbles and roars under the pressure of escaping steam, emitting a smell like that of bilge-water, and seems to proceed from some Plutonic reservoir.

Dr. James Blake, in giving the results of his observations on the Geysers, says that the water of the Devil's Inkstand contains nine per cent of solid matter in the form of soluble salts and sediment, the former being in the proportion of 2.7 per cent, the remaining ingredients being in the form of a dark black sediment. The matter has a thoroughly acid reaction, which it owes to the presence of free sulphuric acid. It would seem that a large portion of the soluble matter is composed of ammoniacal salts, probably the sulphate of ammonia. This salt, which rarely occurs in the natural state, has been found by Mr. Durand precipitated in large quantities from the vaporous exhalations at the Geysers. Dr. Blake's analysis of the water of the Devil's Inkstand shows that about fifty per cent of the saline ingredients consists of volatile salts, the remainder being salts of magnesia, lime, alumina, and iron. The presence of so large a quantity of ammoniacal salts in the water of a mineral spring is quite exceptional. These salts have long been recognized as occurring in the fumeroles, in the neighborhood of volcanoes, and their origin, particularly in such large quantities as at these Geysers, opens up some very interesting questions as to the nature of the strata from which so much nitrogenous matter can be derived. The sediment in the above water, in the proportion of more than an ounce to a quart, is probably some compound of iron and sulphur. Professor Whitney, of the Geological Survey, accounts for the black color and villainous smell of the water in the Witches' Caldron as follows: the iron held in solution comes in contact with water holding sulphureted hydrogen, when an ink-black precipitate of sulphuret of iron takes place.

Wherever one treads, going up the Devil's Cañon, the step slips or crunches on some of the chemical products of these springs. One place, called the crater, a circular cavity of considerable depth, with a level, hollow-sounding floor, is evidently the site of exhausted thermal action, where the mineral constituents in the rock had all been slacked out and the ground had sunken in; though about the lips of this "crater" one or two vigorous steam-vents are still in operation, and sulphur continues to be deposited in fine needle-crystals. Half a mile below Geyser Cañon are a large sulphur heap, incrustations, and other

evidences of former activity, some heat still remaining in places. Four miles up the Pluton Creek occur what are called the "Little Geysers," similar in character to the larger ones, except that they issue from a gently sloping hill-side, instead of a deep gorge. The rocks and the chemical action are the same.

As to the origin of the phenomena we have been describing, it may be said that there are two theories—volcanic and chemical.

In spite of the hot water, the steam, and the saline deposits, vegetation flourishes far down the slopes of Geyser Cañon, about the margins, and in some of the very waters. Dr. Blake found two forms of plant-life in a spring having as high a temperature as 198 degrees. These were delicate microscopic confervæ. In a spring having a temperature of 174 degrees, many oscillariæ were found, which, by the interlacement of their delicate fibres formed a semi-gelatinous mass. In a spring of the temperature of 134 degrees, layers of filamentous green and red algæ were freely formed as the water flowed over the rocks. Unusual masses of oscillariæ flourish in the waters of Pluton Creek. Their presence in the highly mineralized waters of a spring with a temperature of 174 degrees shows how great is the range of the conditions in which these forms of plant-life can be developed.

A roving hunter, of the true Leatherstocking sort, named Elliot, was the first white man who found the Geysers, in 1847. Coming suddenly to the edge of the cañon, he was amazed at what he beheld, and on returning to his companions, told them, in his rough way, he had found the mouth of the infernal regions. (117)

A NEW FUEL—CARBONITE.

A NEW fuel has recently made its appearance in our market, which, on account of its intrinsic value as well as its novelty, is deserving of notice. Although a natural production, it can hardly be called a coal; and although possessing to some extent the properties of coke, it is not produced by any of the methods common to the manufacture of coke. The proprietors have given it the appropriate name of "carbonite." It is found to a limited extent in the bituminous coal fields of Central Virginia, constituting a distinct vein by itself, which is now fairly developed and yielding a steady supply. It is sold in lumps like cannel coal. The surface when broken is dull in appearance instead of glossy, as is the case with cannel or anthracite coal. It burns with a bright flame when first ignited, and almost without smoke, and subsequently set-

tles down into a bed of bright coals not unlike anthracite in appearance, but lacking the intensity of heat produced by anthracite, and at the same time more enduring. It seems to be especially suitable for open grates, and more particularly for parlor use, on account of its freedom from smoke or bituminous smell, and also from the small proportion of ashes (only 2¼ per cent) resulting from combustion. The ashes are also of such density that, in the process of stirring or removing, they do not rise into the room.

The analysis recently made by Dr. Wallace, of Glasgow, and given below, shows a larger proportion of combustible matter than is found in any known fuel, being 96 per cent that is available for producing heat. It has but a slight trace of sulphur, and is therefore free from the pungent odor and gas incident to anthracite coal. It is superior to any other fuel in the power of producing steam, and may prove especially desirable for steamships making long voyages, on account of its economy of space.

ANALYSIS.

Volatile combustible matter	14.26
Fixed carbon	81.61
Sulphur	.33
Ash	2.24
Water at 212° Fahr	1.56
	100.00

This unique product of the earth is accounted for as follows: Originally a vein of bituminous coal, but lying upon and covered with a fine clay, it appears to have been subjected to heat by an overflow of trap rock on the surface, thereby expelling the gaseous and volatile properties of the coal. A process of nature has thus accomplished on a grand scale a more perfect result than is attainable by artificial means, and has delivered for human use a deposit of natural coke, so condensed, by the process under which it was formed, as to acquire a specific gravity nearly the same as bituminous coal, and possessing a heating power fully equal to our best anthracite.

GEOLOGICAL DISTRIBUTION OF GOITRE IN ENGLAND.

AT the recent meeting of the British Association, Mr. G. A. Lebour, of the Geological Survey, read a paper on the "Distribution of Goitre in England geologically considered." He states that goitre is absent on tertiary rocks, but present to a slight extent, and in a scattered manner, on chalk, lower greensand, and Weald clay and Hastings sand, coinciding with the presence of sulphates of lime and magnesia in common with iron. It is absent on the

oolites, and also on the lias, with one exception. It is also absent on the new red sandstone, but present to a very slight degree on the magnesian limestone. The coal measures and millstone grit are free from it, as also are the older and igneous rocks, and it is found again on the carboniferous limestone.

A SPLENDID CONTRIBUTION TO SCIENCE.

JAMES LICK, ESQ., of San Francisco, has donated to the Academy of Science in that city property to the amount of half a million dollars, to which perhaps half a million more will be added, if need be, for the purpose of establishing a new astronomical observatory on the Sierra Nevada Mountains. The new observatory is to be supplied with a gigantic refracting telescope—the largest that it is possible in the present state of mechanical skill to make. It is believed that the object-glass will be about 3½ feet in diameter.

ZINC AND ALUMINUM IN THE SUN.

BY N. LOCKYER.—The observation that the number and length of the lines in the spectra of metallic vapors depend upon the density of the absorbing or radiating vapor, and that only the longest lines remain visible when the vapors are rarefied, obtains additional importance by the author's discovery *that the inverted lines in the solar spectrum are without exception the longest lines observed in the spectrum of the vapor of each element.* The presence of zinc and aluminum in the sun had hitherto been extremely doubtful, as only very few lines of their spectra had been found inverted in the solar spectrum; this doubt we may now consider as removed, since the author has found that the lines corresponding to these elements in the solar spectrum are the longest lines of the spectra of their vapors.

KONGSBERGITE—A NEW SILVER-AMALGAM.

BY F. PISANI.—A sample of native silver of a dead-white color, from the Konsberg mine in Norway, occurring in large cubes, the angles of which were often deeply truncated, gave on analysis, silver = 95.26, mercury = 4.74. Another sample from the same place, the crystals of which were smaller and not so well defined, of a brass-yellow color from iridescence, gave silver = 94.94, mercury = 5.06. The mean of these two results corresponds with the formula, $Ag_{36}Hg$. If the above composition be not accidental, but be confirmed by the discovery of other specimens, it is proposed to call the mineral *Kongsbergite.*

(552) RICHARD ANTHONY PROCTOR. (SEE BIOGRAPHY.)

ASTRONOMY.

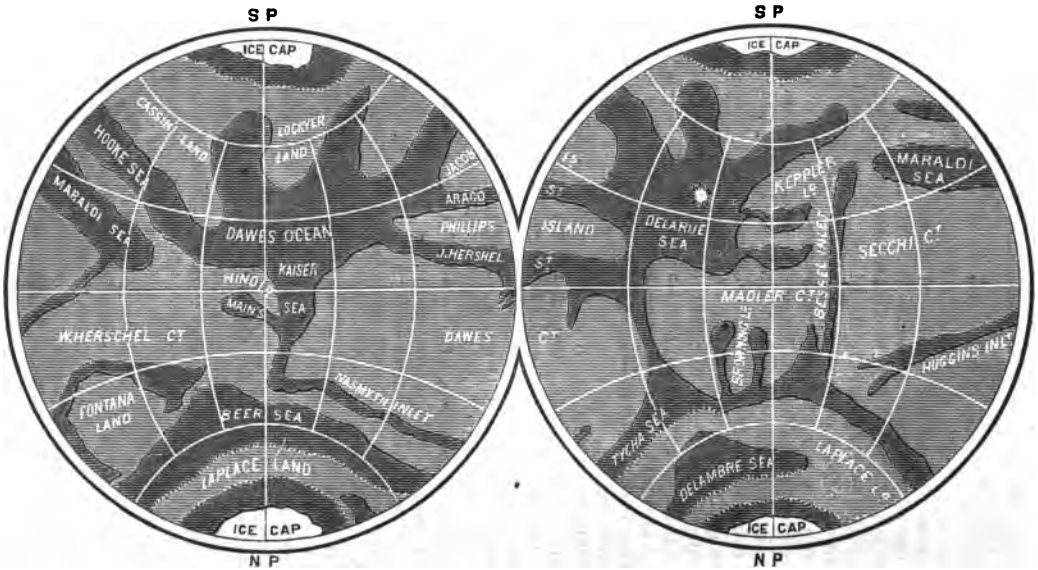
THE PLANET MARS—IS IT INHABITED?

CAN it be possible that in all the vast universe but a single planet, and that the merest infinitesimal portion of the grand whole, can be the abode of living creatures such as ourselves? Does Science teach that other worlds are unpeopled deserts, serving no other purpose than to traverse their orbits obedient to the divine will? Such are the questions which astronomers have been forced to meet and answer, unaided except by the testimony afforded by analogy and by deductions from theory, based perhaps on evidence mainly presumptive.

Mars is frequently visible in the evening heavens, a ruddy star in or near the constellation *Virgo*. Forty millions of miles, at least, divide us from the bright globe of light which modern revelation tells us is the miniature of our own earth; 5000 miles is its diameter. Comparing the relative densities, Mars is about three fourths that of the earth, hence the force of gravity at its surface is much less than the corresponding terrestrial attraction. If, therefore, the inhabitants of that planet are proportioned similarly to ourselves, their strength must be far greater in reference to their dead weight than is the case with us.

Jupiter and Saturn are almost constantly obscured by their closed envelopes, so that their true surface is rarely if ever beheld. Uranus and Neptune are mere points of light. Mercury is almost always eclipsed by the rays of the sun. Venus, nearly twice as large as Mars in diameter, is nearer to the earth, and comes within 30,000,000 miles of us, but travels between the earth and the sun, so that her bright face is turned to that luminary and her dark hemisphere toward us. Hence Mars is the best fitted for examination.

In regarding the planet through a powerful telescope, it is at once observable that the poles are marked by brilliantly white zones which, it is believed, are caused by deposits of snow and ice. These arctic regions appear to extend during the Martial winter to parallel 45° of latitude, or as if the ice of North-America, in our winter, should reach down as far as the northern part of New-York State. We have said that Mars is ruddy, and the fact is easily discernible by the naked eye. Aided by the telescope, however, the surface appears to be far from uniformly red. The color is confined to particular spots or regions, the intermediate parts being of a greenish hue. Observations extending over long periods have demonstrated that the



THE HEMISPHERES OF MARS.

relative position of these divisions has never changed, hence they are not accidental phenomena. Thus, being considered as physical peculiarities, they have been made the subject of close study by almost all eminent astronomers.

For reasons which we shall explain hereafter, the red portions of the planet have been considered as land and the green regions as water, and their appearance has been carefully mapped.

We give herewith a map, constructed by Mr. R. A. Proctor from a number of drawings, in which the various seas and continents are marked with the names of noted astronomers, by which they are distinguished. It will be observed that the seas seen are all land-locked—true mediterraneans—and communicate with each other only by narrow straits. The most remarkable features are the great equatorial zone of continents—of which there are four, namely, Herschel, Dawes, Madler, and Secchi—and the peculiar forms of the bell-shaped seas in the first of these grand divisions.

The waters, or rather the spots which we assume to be fluid, are of the same color as terrestrial seas, grayish green; but the land is a uniform ochreous red. To explain this latter peculiar tint, various theories have been propounded. It was at first supposed to be due to the atmosphere; but this view was soon abandoned; and at the present time it is generally believed to be the prevailing tint not only of the soil but of the vegetation, so that instead of verdant expanse or prairie or green forests, the eye is met by crimson trees or scarlet grass, and the dull lurid shades peculiar to such hues.

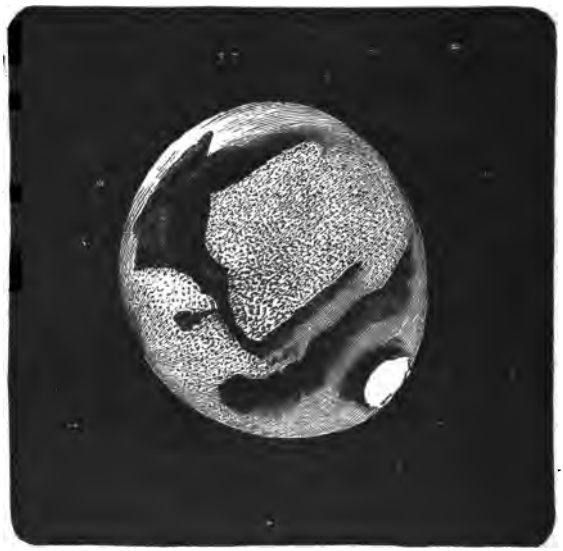
But it may well be urged that we are assuming too much in jumping to the conclusion that the red spots on Mars are land, the green ones water, and the white ones ice and snow. What proof have we that land, water, and ice exist on the planet at all? Mars has *clouds*.

The telescope has told its story. The spectroscope, in the hands of the eminent English physicist Huggins, has conclusively shown the presence of vapor of water in the atmosphere of Mars.

The spectroscopic lines the observer found to be the signatures, not of oxygen nor nitrogen, but simply of the vapor of water, of the same chemical composition as our own, oxygen and hydrogen. This proved, in this direction we need go no further; the existence of sea, of cloud, snow, ice, fog, and rain is demonstrated. Reasoning from this basis, we can trace the presence of winds which shift the masses of vapor from place to place, of aërial and

ocean currents, of rivers flowing to the seas, of a climate tempered in the same manner as our own, and of copious rainfall which must nourish the land and cause the production of vegetation. If, further, there be continents and oceans, similar geological forces to those of the earth must be at work; there must be upheavals and depressions, mountains, valleys, and watersheds—in fact, a miniature of our earth.

Here, then, millions of miles away in space, is another world—a small one, it is true, and seeming to the eye no larger than our engraving, which represents its appearance as seen through the telescope. It has water, air,



TELESCOPIC APPEARANCE OF MARS.

light, winds, clouds, rains, seasons, rivers, brooks, valleys, mountains, all like ours.

"All the circumstances necessary for the production of animate existence being there, under what pretext, then," demand the believers in the habitability of the planet, "can it be asserted that living organisms, such as, under precisely similar conditions, exist upon our own earth, do not live and flourish there?" Owing to the eccentricity of its orbit, the amount of light and heat received by Mars from the sun must vary considerably. Further, we may

add that while the earth is 92,000,000 of miles from our source of light, the distance between that luminary and Mars is fully 141,000,000 miles. From this difference, and the relative sizes of the two planets, we can determine the amount of heat transmitted to Mars as compared with the quantity reaching the earth; and the average daily supply is found to be as two to five. More nearly, when Mars is closest to the sun, he receives somewhat more than half as much heat as the earth; when furthest, his supply falls to a little over one third that of our sphere. The sun would appear, to a person on his surface, to be about one third the size that it does to us.

If, then, Mars, which we have proved to receive a far less quantity of heat than the earth, has been thus deprived during countless ages, it must be apparent that, if it require existing circumstances upon the earth to maintain the creatures thereon, the absence of such circumstances on Mars clearly shows the unfitness of that planet as a habitation for beings.

We have no reason to believe that Mars has been hotter than our globe, and hence, as its sphere is smaller, it must now be a much colder body.

If we suppose that the Martial air is moderately dense, comparable, in fact, to our own air, then, since we know that considerable quantities of aqueous vapor are raised into that air, we must, from the circumstances already considered, conclude that there would be a precipitation of snow which would keep the surface of Mars permanently covered. But this is not the case, as Mars is not a white planet; and so we must assume so great a rarity of its atmosphere that sufficient water vapor can never be raised to produce a permanent snow envelope by precipitation. Consequently, it is probably the most satisfactory course to return to our first assumption, namely, that the Martial atmosphere bears the same relation to the mass of Mars as the terrestrial atmosphere to that of the earth. Under this hypothesis, it can be shown that the atmospheric pressure on Mars corresponds to about 4½ inches of the mercurial barometer. Can man exist for any length of time in such an atmosphere?

In 1862, the enormous height of 37,000 feet above the sea level was attained. At 29,000 feet, Mr. Glaisher fainted, and did not revive until the balloon had descended and returned to the same point. At 37,000 feet the barometer stood at 7 inches, and the thermometer at 12° below zero. Coxwell became almost paralyzed, and only saved the life of himself and his fellow-aeronaut by seizing the valve-rope with his teeth, and thus allowing the gas to escape. If, by

extreme fortitude, one man has managed to live at two miles above the fainting level of another, could human beings generally exist in an atmosphere reduced to five sevenths the density?

Mars has not only a far greater degree of cold, but an atmosphere of much greater tenuity than that of the earth, conditions manifestly incompatible with the existence of terrestrial creatures: a conclusion easily attained by considering the life (mere microscopic animalculæ) found on the mountain peaks of our earth, beyond the last stages of vegetation, where the air is rare and extreme cold prevails.

The weight of evidence, it seems to us, is against the existence of beings of a nature with which we are familiar. No terrestrial creature could live even in the torrid zone, so cold and dismal must it be. Even vegetable life, however hardy, would not survive a single hour. If inhabitants there be, they must be of different form from us, to correspond to the decreased attraction of gravity; if red vegetation exist, their eyes must be different from ours; to live in such an atmosphere, their respiratory organs must be totally unlike our own; and thus we might go on specifying points of variance, until we find that, in the end, there is no more possibility of Mars being inhabited by beings like ourselves than there is of the sun or Jupiter being similarly peopled. In fine, we can not say whether other worlds are or are not abodes of life. We can assert with reasonable probability that on no other planet are there conditions suitable for the existence known in our globe. Whether there be beings in the fiery vapors of the sun, on the molten mass of Jupiter, in the bleak deserts of the moon, or in those remote parts of the universe, from which our entire solar system seems but as a single bright star, is a problem within the knowledge of only Him "to whom all things are possible."

THE SURFACE OF THE MOON.

MR. MERLIN, of the British Consulate at Athens, says, May not the white telescopic appearance of the moon's surface, resembling snow in many parts, be explained by the fact that the extinct volcanoes of our satellite are covered with crystals of salt?

Any person who is accustomed to view the moon through a telescope must, I think, have been struck with the dazzling snow-like appearance of the mountains. May not an explanation of this be deduced from the experiences gained by the last eruption of Vesuvius? The burning lava in that instance retained an enormous

quantity of salt, which did not escape until the mass became cool, when the whole stretch of lava emitted in 1872 was covered with a crust of this substance.

THE TRANSIT OF VENUS IN 1874.

THE year 1874 is a very notable year in the history of science, for in it, on the 9th of December, will occur the phenomenon known to astronomers as the transit of Venus. More than one hundred years have elapsed since the last occasion of this transit; another will happen in 1882, for, according to the laws which govern the respective mo-

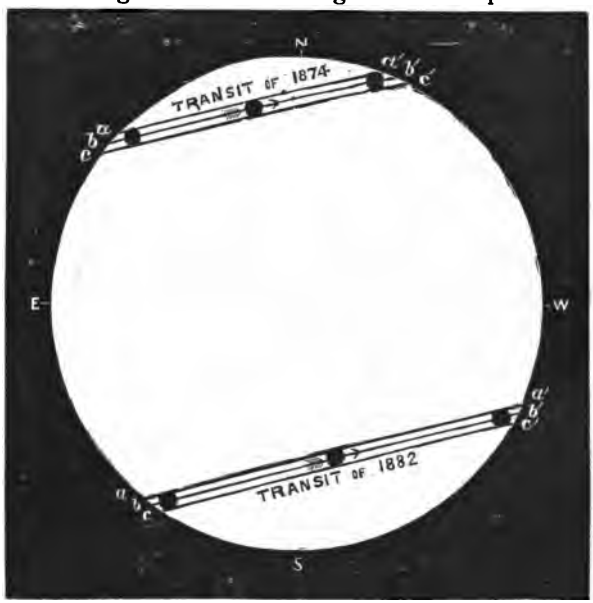


FIG. 1.—PATHS OF THE PLANET IN 1874 AND IN 1882.

tions of Venus and the earth, the transits, when they do happen, occur in couples at comparatively short intervals; but there will then be no other transit until the year 2004.

The phenomenon alluded to is the passage of the planet Venus between the earth and the sun, in such a position with regard to the earth's orbit, that Venus is seen to move like a round black spot over the sun's face. The importance of this phenomenon, in a scientific point of view, may be judged from the fact that it affords astrono-

mers the best means of measuring the distances of the heavenly bodies, and of ascertaining their weight and dimensions.

The first occasion on which a transit of Venus was observed for this purpose was in 1761, the eminent astronomer, Dr. Halley, having recommended the method, and devised a plan of operation to be used after his death, as he knew he could not live until the occasion arose. The plan, however, was carried out at first imperfectly, and consequently with inferior results; but in preparation for the following transit, in 1769, complete arrangements were made by the Royal Society, as well as by other learned bodies in Europe. The Royal Society dispatched a vessel, under the command of the celebrated Captain Cook, to the South Seas to take observations; and it was in this voyage that Cook explored the coast of New-Holland, now known as Australia, and took possession of that important island in the name of Great Britain.

The observations of 1769 have formed the basis of nearly all the accepted facts of modern astronomy, so far as the computation of distance, etc., is concerned. On these data it is that we have all learned from our early years that the sun is distant from the earth more than ninety millions of miles; that Mercury, the planet nearest to the sun, is 36,800,000 miles away from it; that the distance of Venus from the sun is more than 68,000,000 miles, and so on. But it is a singular fact that, notwithstanding the care with which the observations were made in 1769, and the frequency with which these observations and the calculations based on them passed under the examination of the most distinguished astronomers, it was discovered only a few years back that certain errors had crept into the reckoning, by which the sun's distance was over-estimated by about four millions of miles. This error had necessarily affected all the other computations, so that for nearly a century, as one writer has put the matter, the distances of all the heavenly bodies were overrated by an amount equal to tenpence in the pound, and their weights by as much as half-a-crown in the pound; and these inaccuracies will be found in the best authorities on the subject, except those which have passed through recent editions.

The discovery of such errors, under the severe processes by which modern research is conducted, has led to increased anxiety on the part of the scientific world to secure the most perfect accuracy in every detail connected with the next transit. It will therefore be watched with the greatest care by astronomers all over the globe;

their observations will afterward be compared, and the results finally given to the world will, it is hoped, satisfactorily settle the questions involved. The recurrence of a transit in 1882 will afford an opportunity for devoting renewed attention to any point or points that may be left in doubt by the transit of 1874; and, in the present state of scientific knowledge, we may expect a much nearer approach to absolute accuracy than was possible in the last century.

The transit of December 9th, 1874, will be invisible in the United States and the British Isles, as it will take place in the early morning hours of English time, between half-past one and half-past six. It will be well seen at Alexandria, in Northern India, in Australia and New-Zealand, the Mauritius, etc., and at all these points, as well as others, there will be experienced observers. An expedition will also be sent by the British Government to the Antarctic Seas, and other nations will have their observing parties at different stations. The reason of this great variety of stations, apart from the fundamental necessity that observations should be taken at parts of the earth as widely distant as possible, is that the state of the weather and condition of the atmosphere at some of the places may not allow a clear view of the passage of the planet over the sun's disc; and therefore, if observation should altogether fail at some points, it will undoubtedly be successful at others.

To fully explain the phenomenon of the transit, and the calculations depending upon it, would require a treatise, and the frequent use of mathematical terms; but an idea of the subject may be gained very easily. Every one knows that if you look at any near object from a certain standpoint, and then change your position to another standpoint and gaze at it again, the object itself will appear displaced, or in another position relatively to that you occupy. The nearer the object may be, the greater the displacement; and the farther it is, the less the effect of your own removal. This palpable rule forms an elementary principle of all surveying, and the distance of an object is determined by taking the angles relatively to the base line, or straight line described between one point and another to which the observer removes. Now, if we attempt to apply this principle to the calculation of distance of the heavenly bodies, we find that we must take a very long base line indeed before we have any apparent displacement in position (called by astronomers *parallax*) of even the nearest, which is our own satellite, the moon. The longest base line which it would be possible to com-

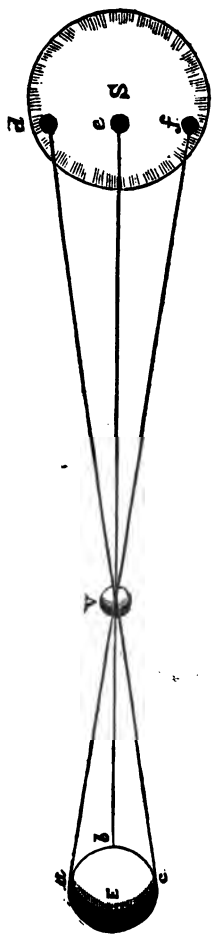


FIG. 2. — APPARENT DISPLACEMENT OF THE PLANET.

mand is that afforded by the diameter of the globe on which we live, namely, in round numbers, 7900 miles. But so insignificant is this distance compared with that of the sun, that to two observers stationed at opposite sides of the earth, the sun's centre would appear to both in the same point of the heavens. We can find no apparent displacement or *parallax* from the most widely extended observations. But, when it happens that Venus in her orbit comes directly between the earth and the sun, as her distance from us is considerably less than the sun's, it follows that observers, stationed at opposite sides of the earth, will see Venus on different points of the sun's disc. This will be made clear to the eye by a reference to our diagram, (Fig. 2.)

It will here be seen that if three observers, stationed respectively at *a*, *b*, and *c* on the earth's surface, note the transit of Venus at the same instant of time, she will appear to each of them to be on a different part of the sun's surface. An observer at *a* will see the planet projected at *f*; another stationed at *c* will note the planet at *d*; while to *b*, on the centre of that portion of the earth which is turned to the sun, the planet will occupy a place in the centre of the sun's disc. It must be understood that the figure is not intended to convey a correct idea of the relative proportions of the respective bodies, nor of the actual *parallax*, but only to illustrate the principle on which the observation is founded.

The points of chief importance in making observations in the transit are the moments of ingress and egress of the planet—that is, when its black shadow first appears in contact with the lumina-

ry; again when the whole of the dark surface is fully projected; and lastly, when the planet reaches the sun's opposite margin, begins to disappear, and finally vanishes. All these points, noted and timed by different observers all over the globe as far as practicable, and afterward compared one with the other, give the data for a perfect record of the transit, and for the important results already mentioned.

Our first figure shows the portion of the sun's disk which will be passed by the planet in its transits of 1874 and of 1882 respectively. The marks *a*, *b*, and *c* indicate the lines which the planet will appear to traverse when viewed from different positions on our globe. At the northerly stations, Venus will seem to pass a more southerly course on the sun, or along the line *c*, *c'*. At the southerly posts of observation, she will appear on the sun's more northerly line, *a*, *a'*; while at the central points the line of transit will be *b*, *b'*.

An explanation of the transit, with other interesting information, has been given by Professor C. A. Young, in a recent lecture. Modern science traces to the sun almost the whole range of terrestrial activity. We can easily follow out the solar action in our winds and no less easily in our waterfalls. The pumps that raise water to the hills are in the sun. The power that is expended in intercepting water in its downward flow is at the expense of solar fires. In a more remote way we may trace to the sun the steam power which is derived from fuel. The very force with which we move our limbs, the sound of our voices, even the power of mind, the impulses exerted in forming thought, in exciting emotions, are sun-derived, when traced to their ultimate source.

DISTANCE OF THE SUN.

The first point to be ascertained in relation to the sun, or indeed to any of the heavenly bodies, is its distance from the earth. The method of actually measuring the intervening space which can be most relied upon is by means of the transit of Venus. The planet will meet the eastern side of the sun's disk near the northern edge and will pass obliquely across. In Fig. 3, A and B represent stations on opposite sides of the earth, and *a* a portion of the earth's orbit. V is the planet Venus and U a portion of its path. S the sun. C D and E F represent the apparent paths of the planet across the sun's disk. Fig. 4 shows the track of Venus more clearly. The upper and dark circle represents the planet as seen from the southern hemisphere, and the lower light circle, the planet as seen from the northern. The arrow shows the di-

rection of the motion. The problem is to measure the distance between the centre of the black dot on the great face of the sun to the edge of the latter with the utmost

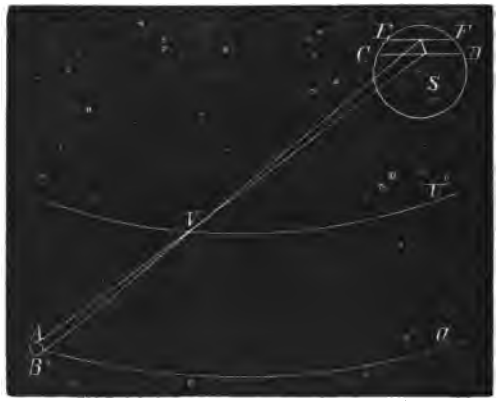


FIG. 3.

accuracy. An error of a hundredth part of a foot, at a distance of about 40 miles, would be fatal to any increase of the accuracy of our present knowledge.

STATIONS ON THE EARTH.

The earth must be regarded as seen from the sun the moment when the planet strikes the disk of the sun, provided an observer on the earth were at its centre. At that moment, we must suppose ourselves transported to the sun, looking toward the earth. This will show the apparent path of the shadow of Venus upon the earth.

Stations are selected around the edges of the world, all along in Japan, Kamschatka, Siberia, China, and Siam, in the northern hemisphere, and in New-Zealand and in some islands in the Southern Ocean.

METHODS AND INSTRUMENTS EMPLOYED.

In measuring this distance, there will be three different methods pursued. The old-fashioned way was to note when the planet strikes the sun and when it leaves it, from which we may know the number of hours it takes to pass across the disk of the sun. Thus at the northern station we have the length of the chord which it passes over, and the same at the southern station; and knowing the length of the two chords, it is not difficult to compute the distance between them. Sir George B. Airy, the Astronomer Royal of England, is disposed to rely mainly

upon that method. But there are great difficulties with it. The main difficulty is this: A bright object looks to the eye larger than its real size; and a dark body projected upon it looks smaller than its real size, so that it is difficult to determine the precise moment when the planet enters upon the sun's disk.

Another method, which will be used mainly by the German astronomers, is to measure the position of this spot from time to time in reference to the edges of the sun's disk by means of the heliometer, an instrument by which we can measure very accurately the distance of the little

FIG. 4.

round spot from the edge of the bright circle on which it will be shown. The other method, which will be used by all the nations, but will be mainly relied upon by the French and Americans, is by photography.

The English will use a common telescope, driven by clock-work, with an eyepiece to enlarge the image of the sun to about four inches in diameter. With this they will from moment to moment take photographs of the solar disk while the transit is going on, and they will afterward measure those photographs. The objection to this method is, that the eyepiece used to enlarge an otherwise too small image almost invariably produces a certain amount of distortion. The round image will not be round on the glass or paper, and it is very difficult to allow for that distortion. They propose to photograph with the same apparatus a scale of equal parts, putting up a board perhaps as long as this room, with laths nailed upon it at equal distances, to be photographed, and thus they pro-

pose to calculate, by comparison, the distortion of the different parts of the field of view.

The Germans will use a telescope of the same kind and an eyepiece of the same kind; but at the focus of their telescope they will place a piece of glass ruled with fine lines into squares. These will be measured beforehand very carefully, and the image of the sun and these ruled lines being photographed together, if there is any distortion it will affect these little squares precisely as it affects the sun; and they need only refer their measure to the nearest lines of this net-work to get an accurate result.

The best plan will be that pursued by the French and the Americans and by Lord Lindsay's party from England.

The telescope will be 30 or 40 feet long—it need not be very large in diameter—and the image will be large enough not to require enlargement. Of course such a telescope would be very unwieldy if mounted in the usual way; and the method proposed is to put the telescope horizontally, perhaps in a tunnel underground to protect it from currents of air, though that is not essential, and to throw the image of the sun into the object glass by means of a flat mirror. In this case "flat" means a great deal. It is very difficult to make a mirror flat; and that is the difficulty in this method. The mirror must be so flat that at no point shall the curvature equal a radius of 18 miles.

NATIONAL EXPEDITIONS.

Russia will establish twenty-five stations in her Siberian dominions.

France will send expeditions to Palestine, the Red Sea, Pekin and Japan, the island of St. Paul, New-Caledonia, and possibly to the Sandwich Islands.

The Germans will send to the Falkland Islands, McDonnel's Island, and Kerguelen's Island, in the southern hemisphere.

The English will send to Oahu, to Roderick's Island, to the Falkland Islands, and to Alexandria, in northern India.

Lord Lindsay will send a private expedition to Mauritius.

The United States will send out eight parties; four to Japan and China, and the other four to New-Zealand, the Falkland Islands, Van Diemen's Land, and possibly Kerguelen's Island.

INFORMATION CONCERNING THE SUN.

At present we consider the distance of the sun from the earth to be 92,000,000 of miles, with a margin of error of about 500,000 miles.

MISCELLANEOUS.

AIDS TO THE ART OF DRAWING.

THERE is no accomplishment which is of more genuine advantage than a fair knowledge of drawing. It is, in brief, a universal language which places its possessor in communication with the whole world; and while it is not needful that every man should be capable of producing effects which may be classified as finished works of art, the power of making a neat sketch, correctly proportioned, and also displaying an idea in a graphic manner so as to explain itself at a single glance, is an ability which can not but be of the greatest value in the saving of both money and time.

As the majority of persons, however, are unable to handle the pencil with a sufficient degree of skill to depict their thoughts in a clear and comprehensive manner upon the blank paper, various ingenious mechanical aids have been contrived by means of which the draftsman is enabled to reproduce a correct outline with comparative ease and rapidity. In the accompanying engravings will be found represented a variety of these devices depicted in the simplest and most practical form with the view of affording the reader a guide for making his own apparatus from the commonest and most readily obtained materials.

AIDS TO DRAWING.—FIG. I.—THE SKETCHING-FRAME.

THE SKETCHING-FRAME.

For those who wish to cultivate the eye, and thus learn to appreciate the difference of distances, without resorting to the more direct tracing of outline necessitated by many of the optical inventions described further on, the arrangement represented in Fig. 1 will be found of much assistance, and particularly in sketching from nature. In this branch of art, the main difficulty lies in seeing too much, and hence, for instance, in an extended prospect, there is a liability to crowd the paper with disproportionate details. Again, the eye naturally seeks for straight lines and boundaries to which to refer, and these absent, the mind is obliged to carry imaginary limits, a proceeding of no small difficulty to one not well practiced in so doing. The arrangement in Fig. 1 supplies a simple square frame tightly hinged to the top of the ordinary lap drawing-board, so that it will stand in an upright position. Across this is stretched a number of threads or wires at equal distances apart so as to divide the interior space into small squares. The paper on the board is similarly divided by light pencil lines ruled over its surface. In making the sketch, the artist draws so much of the view as he sees through one of his squares in the frame, into the corresponding ruled square on the paper, and thus having a large number of straight lines to refer to is very readily enabled to locate the details of the picture. It is good practice, after

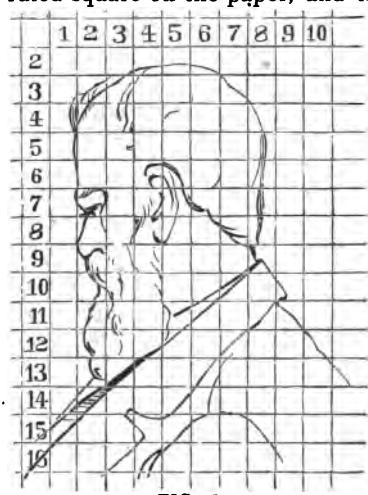


FIG. 2.

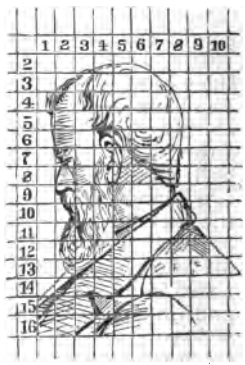


FIG. 3.

AIDS TO DRAWING.—REDUCING BY SQUARES.

employing the frame thus made for some time, to remove

the wires and endeavor to sketch by referring simply to the edges of the former, and by thus progressing, it will be found that before long the apparatus can be entirely dispensed with, the eye becoming sufficiently educated to judge for itself. Of course, the size of the squares ruled upon the paper governs the dimensions of the drawing, and it matters not how small they be made so long as they correspond in number and relative position with those formed by the wires.

COPYING, ENLARGING, OR REDUCING BY SQUARES.

This reduction of squares suggests a convenient mode of reducing or enlarging drawings already completed which is represented in Figs. 2 and 3. Supposing Fig 2. to be the original from which a smaller duplicate is to be made, a number of pencil-lines are lightly ruled over its surface at right angles, and the squares thus formed are for convenience numbered as represented. Then on the blank paper for the copy a similar number of squares are ruled in precisely the same manner, and correspondingly numbered. It is then very easy to fill in each square of the copy exactly so much of the drawing as is seen in the like square of the original. Thus in our figures, the eye in Fig. 2 is in square 2–7, and in Fig. 3, it will be noticed that, though smaller, it occupies precisely the same place.

THE TRANSPARENT TRACING-TABLE.

In copying fine pencil drawings, it would hardly do to rule other pencil-lines over their surface, as the application of bread or rubber to remove the same would destroy the original. In such case, a neat arrangement of transparent tracing-table, as shown in Fig. 4, might be used. This consists of a square-bottomed box, the tops of the sides of which are inclined like those of a writing-desk. The back is open, and as the apparatus rests on the table, abuts against a window. The shade of the latter is drawn down to meet the upper part of the device, so that the light enters through the back of the latter, and the interior being lined with white paper, is reflected up through the inclined glass top. The original drawing might be secured above this glass, and a sheet of tissue-paper, ruled off in squares, placed above it. Being brilliantly illuminated from below, the drawing would readily show through, and thus might be copied square by square, as above described. As represented in our engraving, however, the table is being used for direct tracing. Drawings on even thick antiquarian paper may be attached to the glass, and another sheet of the same material placed above, when still sufficient light will be transmitted to enable the lines

underneath to be clearly seen and readily traced upon the upper sheet. The idea is precisely the same as is ordina-

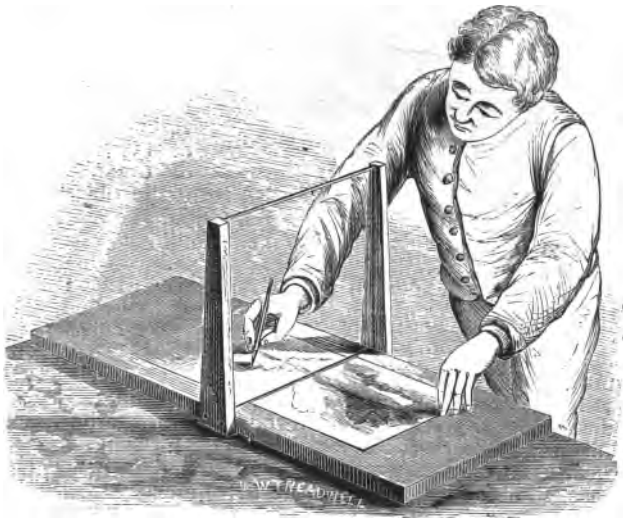
AIDS TO DRAWING.—FIG. 4.—THE TRANSPARENT TRACING-TABLE.

rily carried out in holding a drawing and blank paper up against a window-pane, and tracing the outlines of one upon the surface of the other.

THE REFLECTING DRAWING-BOARD.

The mention of window-glass recalls another use of that valuable commodity for artistic purposes which of late has become quite popular, judging from the multiplicity of copies of the apparatus represented in Fig. 5, for sale in almost every stationer's store. The device will bring Pepper's ghosts to mind, as these supernatural individuals are produced by an arrangement made on precisely the same principle. It is nothing more than a flat board provided with two uprights, both of which with the board are suitably grooved to hold a pane of glass in a perpendicular position. The drawing to be copied is secured to the board on the left of the glass and the blank paper on the right. The artist now stands as represented in our illus-

tration—that is, so as to look down upon the surface of the glass at a very oblique angle. The original drawing is reflected from the polished surface of the pane to his eye, and at the same time he sees the white paper through the transparent glass, so that the lines of the model appear transferred, but reversed of course, upon the paper. These need only be followed with the pencil, and the outline is made. The apparatus is not of great use where reliable work is required, and indeed seems to us little more than a means of amusement. There are two reflections of the original thrown upon the eye, due to the rays striking both surfaces of the glass at unequal angles, which tend to confuse and render the outline indistinct. Again, unless the original be brilliantly illuminated, the shadow is so faint that the black lines of the pencil appear to blot out the finer details of the lighter portions. The glass



AIDS TO DRAWING.—FIG. 5.—THE REFLECTING DRAWING-BOARD.

must be besides accurately perpendicular, as otherwise a very distorted image is produced, and also be entirely free from defects due to imperfect annealing. The best kind to use, we think, is thin French plate, polished as highly as possible.

THE CAMERA LUCIDA.

Probably the most really reliable optical device is the *camera lucida*, represented in Figs. 6 and 7, a simple arrangement extensively used by professional artists for saving time in sketching accurate outlines, of either the same dimensions as those of the originals, or enlarged or reduced. The principle of its construction will be readily understood from the small sketch marked 2 in Fig. 6. The glass is simply a four-sided prism, having one right angle, one of 135°, and two of 67½°. When disposed as represented, the rays from the object pass into it without any appreciable refraction, and are totally reflected from the lower inclined side, and again from the upper inclined side, emerging near the summit in a direction almost perpendicular to the top face, so that the eye sees on the paper placed beneath an image of the object. If this image be traced by the pencil, a very correct outline, not reversed, is obtained. The use of this device requires some practice, as there is a difficulty in seeing both the image and the point of the pencil, for the latter really falls further from the eye than the position of the latter. This may be corrected by placing between the eye and the prism a lens which gives the rays from the pencil and those from the object the same divergence. It is, however, necessary to place the eye very near the edge of the prism, so that the aperture of the pupil is divided into two parts, one of which sees the image and the other the pencil. As will readily be understood, the nearer the object is brought to the prism the larger is its image, and the further away it is removed, the smaller the same, so that reduction or enlargement is thus easily made.

AIDS TO DRAWING.—FIG. 6.—THE CAMERA LUCIDA.

Fig. 6 shows the mode of placing the eye, and also the disposition of the apparatus, the construction of which will be understood from the larger view, Fig. 7. This last

mentioned drawing has been made directly from the instrument constantly used by Mr. H. E. Mead, special artist of the SCIENTIFIC AMERICAN, and to that gentleman we are indebted for an explanation of an ingenious manner of constructing a device as represented from wood and other simple materials. The prism can be obtained at a small cost from any optician, and the rest of the apparatus any one can cut out of black-walnut with a knife, and perhaps a gimlet or two. The thumbscrews used are of brass, of the kind employed for shutter-fastenings, and can be procured of any hardware dealer for a few cents each. B, in Fig. 7, is the prism and A is a section of one of the joints, showing how the apparatus may be easily adjusted. A movable rod secured by a thumbscrew regulates the height of the prism, and the simple clamp shown secures it to the edge of the table. The entire arrangement thus constructed, we are informed, costs, exclusive of the prism, a little over one dollar.

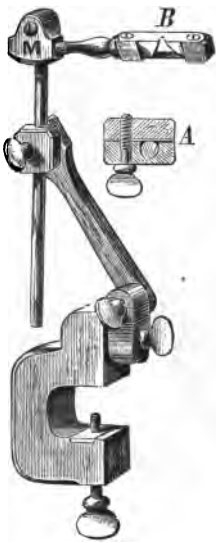
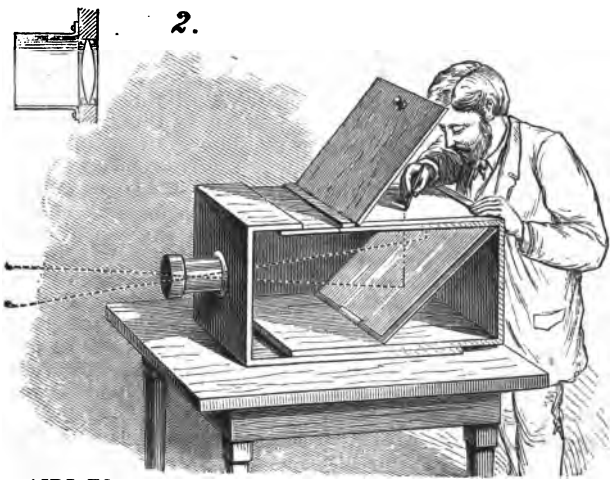


FIG. 7.



AIDS TO DRAWING.—FIG. 8.—THE CAMERA OBSCURA.

THE CAMERA OBSCURA.

One of the best known instruments, also based on optical principles, and which may be used in drawing, is the *camera obscura*, of which we give two forms. Fig. 8 is an arrangement adapted to taking views from windows or other fixed positions. It is a rectangular wooden box, formed of two parts, which slide in and out. The luminous rays pass into the box by a double convex lens secured in place as represented in section 2, and form an image on the opposite side, which is at the focal distance of the lens. But the rays are reflected from a glass mirror inclined at an angle of 45° and form an image on a piece of ground glass inserted above. When a piece of tracing-paper is laid on this screen, a drawing of the image is easily made. The wooden door shown serves to cut off extraneous light. The parts of the box slide one within the other, like the joints of a telescope, so that by elongating it more or less, the reflected image may be made to fall exactly on the screen, at whatever distance the object may be situated.

THE PORTABLE FIELD CAMERA OBSCURA.

Fig. 9 is another arrangement of the camera obscura, in

AIDS TO DRAWING.—FIG. 9.—THE FIELD CAMERA.

portable form, so as to be carried on sketching tours. The box or lantern portion shown in detail in Fig. 10 consists in front and rear pieces of wood or tin, connected at the sides by cloth or paper, folded like the bellows of an accordeon. In the front side is the lens, placed in a little telescope of tin, which easily slides in and out and inside of the back, and at its lower edge is hinged a small mirror, which, when the box is extended, falls forward until it strikes against a stop within the front side, which maintains it at an angle of 45°. Any convenient arrangement may be added to hold the box extended. When the latter is closed, the mirror folds against the back, the lens telescope slides in, and the front and rear sides come together, making a bundle little larger than a good-sized pocketbook. At each corner is a socket to receive the ends of bent iron wires as shown, which serve as supports, and the lower extremities of which enter sockets attached to the sides of the table, as represented in Fig. 10. The table is composed of slats glued to a back of cloth. On the back of the middle slat is a socket, and also a bar pivoted in the middle, which turns as indicated by the dotted lines, and forms a solid support for the table when extended. The object of making the table thus in pieces is so that it can be rolled in a compact bundle. A tripod of legs jointed to a pivot which fits in the socket under the table supports the apparatus, and may, when detached, be folded into a single bar, serving as a walking-stick. A square of black cloth completes the device, and is thrown around the wires to form a dark-chamber beneath the lens-box, large enough to accommodate the head and hand of the artist. The drawing-paper is attached to the table after it is extended and receives the image formed by the lens and reflected downward by the mirror.

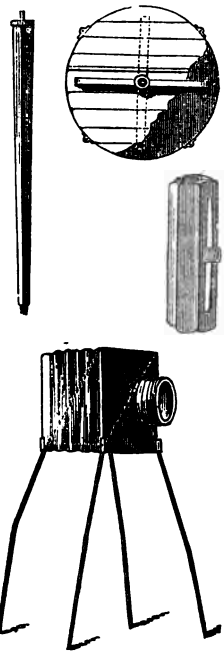


FIG. 10.

FIG. 11.

THE PROPORTIONAL DIVIDERS.

We have still to notice some ingenious devices which are more adapted as aids in mechanical drawing rather than as direct means of tracing outlines, as are the majority of the apparatus thus far described. Fig. 11 is termed a proportional compass, and consists in two slotted arms of brass, German silver or other metal, connected through the slots by a small sliding thumbscrew. Metallic points are provided at both ends of the arms. The object of the device is to reduce or enlarge drawings to a given scale, and for this purpose suitable divisions are marked on the edge of one of the slots. Suppose, for example, it be desired to reduce a given line to one third, the two long points are placed upon its extremities, a pointer on the clamping screw being previously removed to coincide with the $\frac{1}{3}$ mark, so that the same forms the pivoting point of the two arms. The distance then included between the two short points at the opposite ends will be exactly one third the line measured, and hence may be thus laid off on the copy. In enlarging, the operation is reversed, and is too obvious to need explanation. The instrument can be made without difficulty by any one used to working in metals, and the marks on the arm can be obtained by actual experiment. It can be purchased, however, for a small sum from any mathematical-instrument maker.

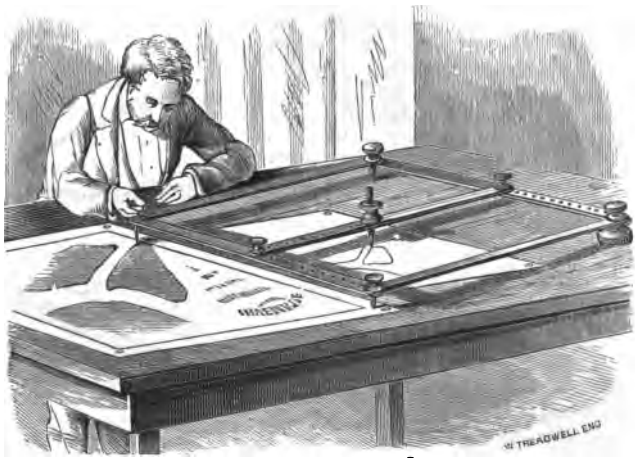
AIDS TO DRAWING.—FIG. 12.—THE PERSPECTIVE RULER.

THE PERSPECTIVE RULER.

Fig. 12 is a simple arrangement for drawing lines in correct perspective, and avoids the difficulties happening when a vanishing-point is marked at a considerable distance from the drawing, and the lines drawn therefrom by a long ruler. It consists in three arms of equal length pivoted together at one end by a screw-clamp. Two pins are inserted in the drawing-board against which two arms of the "perspective linead," as it is termed, abut. The angle of these arms and the position of the pins are governed by the distance required for the vanishing-point, as the greater the angle, the further the same is removed, and *vice versa*. Once adjusted, the parts are clamped firmly together, and the lines ruled by the upper side of the arm which rests upon the paper. Of course, the arms at an angle are always kept in contact with the pins, while the ruling arm, which is the lowest of the three, is moved up or down about the paper. This instrument is easily made of seasoned wood or metal. Two are necessary, right and left handed, owing to the construction, for use on each side of the board.

THE PANTAGRAPH.

In concluding our series, we add an engraving of the pantagraph, Fig. 13, a quite useful instrument, in which



AIDS TO DRAWING.—FIG. 13.—THE PANTAGRAPH.

the principle involved is that of the proportional compass. There are four rulers, jointed together at their intersections, and having at two of the angles, supports terminating in round points, or smoothly running casters. At one of the other angles is a weight to which the apparatus is pivoted, and which holds it in place, and at the fourth corner is a tracing-point, shown in the hand of the operator. Directly across the frame thus made, and pivoted at its ends to the centres of two of the bars, is a fifth ruler, through the middle of which passes a pencil. Along half the length of the two side-bars, and also of the central bar, are made perforations, so that the length of said rulers can be shortened as rendered necessary. The tracing-point is moved over the outline to be followed, and its motion is communicated to the series of rulers which by a kind of parallel movement actuate the pencil to describe precisely the same line, equal in dimension to that of the copy, or enlarged or reduced. Space forbids our entering into the mathematical demonstration of how this instrument reduces or enlarges, but generally it may be stated that the scales of the two drawings are to each other as the distances of the pencil and of the tracing-point from the fulcrum or pivot of the pantagraph, and these distances are adjusted by altering the position of the joints in the holes above noted. Any good mechanic can make the instrument for himself from hard wood, though metal is better. Care must be taken in constructing the joints, as looseness or bad fitting in such places greatly impairs the accuracy of the copy. In fact, any of the devices we have described require but little skill, though perhaps some time and patience in their manufacture. But if properly finished in a workmanlike manner, none will fail to be handy and useful additions to any apprentice's collection of drawing-tools.

A MUNIFICENT GIFT TO SCIENCE.

SOME time since, Professor Agassiz, in an address before the Legislature of Massachusetts, called the attention of that body to the need and value of a summer school for the instruction of both teachers and students in natural history. He also suggested that, during the coming summer, a session should be held on the island of Nantucket.

These remarks attracted the attention of Mr. John Anderson, a wealthy and well-known tobacco merchant of this city, who with great munificence has donated an entire island for the purposes of the institution, supplementing his gift with a fund of $50,000. The island, which bears the name of Penikese, is of about one hundred acres in

extent, and is situated in the Elizabeth group, at the entrance of Buzzard's Bay, on the southern coast of Massachusetts. It has been largely improved, and contains several buildings, valued at $100,000, while the fertility of its soil is such as to render it possible to raise sufficient produce to pay all expenses of the school.

Professor Agassiz considered the site to be eminently suited for the purpose as affording ample opportunity for original investigation as well as instruction. The institution will be carried on throughout the year, in connection with the museum of Cambridge, and measures will be speedily taken to prepare the buildings for use.

NEW WATER-WAY FROM THE GREAT LAKES TO NEW-YORK.

FOR a few past years, the Legislature of New-York has had under consideration the proposition for a ship canal to connect the Bay of New-York with our great interior seas or lakes. The project consists in cutting a canal from the Hudson River at Fort Edward, which is forty miles above Troy, to Whitehall, N. Y., distance 17 miles, the southern extremity of Lake Champlain. It is proposed to make this canal ten feet deep and one hundred and fifty feet wide, thus permitting its navigation by steamers and vessels of 1000 tons burden. From the head of Champlain to the St. Lawrence River, 26 miles, a canal will be built by the Canadians, no locks being required.

The execution of the American portion of this work would involve the deepening of the Hudson between Troy and Fort Edward, and of the lake channel at Whitehall.

The whole cost is estimated at only about eight millions, and on its completion, vessels of one thousand tons would be able to pass between New-York, Chicago, Milwaukee, Duluth, and intermediate places, without breaking bulk, and with a saving of six days' time over the present facilities of the Erie canal. This is a great enterprise, and reflects the highest credit upon all who are engaged in its promotion. Among the prominent individuals whose names are honorably identified with the subject, that of the Hon. Smith Weed, of Plattsburg, N. Y., is conspicuous. The zeal and ability with which he has elucidated the vast advantages of the project, and the wide public attention that he has succeeded in awakening in its behalf, are highly appreciated throughout the State of New-York and the great West. The work is one of national importance, and ought to go forward without delay. To the Empire State alone it would repay its cost by the increase of taxable wealth along its line in less than ten years from its opening for business.

THE CENTENNIAL CELEBRATION OF AMERICAN INDEPENDENCE IN 1876.

THE great labor of organizing an International Universal Exhibition has been vigorously prosecuted during the past year. It was in March, 1871, that the United States Centennial Commission was created by act of Congress. In the early part of the year 1873, the site for the building (in Fairmount Park, Philadelphia) was surveyed, and its topography, means of drainage, water supply, etc., reported on. Forty designs for the structure have been sent in, and the one selected is that of Mr. Calvert Vaux, of New-York. The extent of the accommodation provided will be understood from the following statistics:

The building is made up of twenty-one domed or vaulted pavilions, each 240 feet in diameter, clustered together, and connected by arches of 150 feet opening, and fountain courts 60 feet in diameter.

The visitor is always in an apartment over 200 feet wide, that opens without an intermediate corridor into other apartments, also over 200 feet wide. This result is obtained by employing semicircular roof trusses springing from the ground level.

The main temporary building provides 22 acres of floor space, exclusive of galleries.

Offices for the various exhibiting nations, buffets, retiring-rooms for ladies and gentlemen, and other necessary conveniences, are provided in the gables, as shown on the plan, and sites for exterior restaurants are indicated. Galleries are formed over the offices. A covered piazza surrounds the building, giving access to and communicating with all the entrances and restaurants.

The cost of the design, as modified and much enlarged, has been stated at about $4,000,000.

At the close of the year 1873, the Board of Finance reported that their operations had been chiefly confined to the State of Pennsylvania, in which subscriptions to the amount of $3,500,000 have been taken up. This is nearly four times the quota allotted to that State. The total amount to be raised is $10,000,000. California has promised to take her full share ($145,300). and many other States are organizing committees for the purpose of obtaining substantial aid to the great project. In New-York, a committee of seven gentlemen has been appointed by the Chamber of Commerce, and it is to be hoped that this State will soon undertake to provide the $1,136,660 which represents her share in the national celebration.

Abroad, we hear from Germany, Belgium, Vienna, China, Japan, and other countries, that a lively interest in the

success of the exposition is everywhere manifested. Many of the most valuable exhibits from the Vienna *Ausstellung* are being kept ready for forwarding to Philadelphia. It is a proof of the great interest which attaches to the American celebration that, nearly three years before the opening can take place, foreign nations are already getting together their contributions, and entering for the friendly struggle in the arts, sciences, and industries to which we invite the peoples of the world.

It is intended to open the Centennial exposition on May 1, 1876, and to close it on November 30, 1876. All applications for space must be made previously to March 4, 1875, and all exhibits must be forwarded so as to arrive in Philadelphia on or before March 4, 1876.

Among other special attractions is the erection of an iron tower, 1000 feet high, higher than any other structure in the world. It is intended to be a permanent memorial of the great event of 1876. The design and plans are complete. It is to be built by Messrs. Clarke, Reeves & Co., of Phœnixville Bridge Works, Pennsylvania, and is to cost $1,000,000. Elevators capable of carrying 500 persons to the summit in an hour (four elevators being used, the ascent taking three minutes' time) will be provided in the central shaft. By this means, the visitors to the exposition will be afforded a view of unprecedented extent over the neighboring country.

THE WORLD'S FAIR AT VIENNA.

IN our last year's RECORD, we gave a sketch of the great building then in process of erection for the World's Fair, and particulars of the enormous dimensions of the building erected for the purposes of the great exposition.

The formal opening of the fair took place on the 1st of May, 1873. At an early hour, a vast crowd thronged the avenues leading to the great edifice, and when the twenty doors were thrown open, surged into the immense hall, filling every available space. The scene is described as one of wonderful impressiveness and grandeur; the motley costumes of the multitude, representative of almost every nation, the brilliant decorations of the throne, and the gigantic proportions of the building, together forming a spectacle of imposing magnificence.

At noon, the Emperor of Austria, with the Empress, the Crown Prince of Germany, the Prince of Wales, and other royal guests, with the high officials of the empire, arrived, and were received with a tremendous popular ovation. The Arch-Duke Charles Louis, patron of the exposition, opened the proceedings by delivering an address, which

was responded to by the emperor, who, in a few words from the throne, welcomed the visiting nations and declared the exposition open.

The exposition remained open until Nov. 1st, 1873, when it was officially closed. But it is understood that the grand building will be preserved and converted to the purposes of a national museum. The Congress of the United States appropriated three hundred thousand dollars in money, employed two vessels to convey goods for exhibitors, and in other ways took part in the exhibition. But our countrymen took no very great interest in it, and the display of goods from the United States, although creditable, was not extensive. An immense number of prizes, diplomas, etc., were distributed, and the awards were shared by almost every nation in the world.

In new and useful appliances for the arts, steam-engines, sewing-machines, reaping and mowing machines, the United States took the lead, and Yankee ideas, copied and reproduced in all sorts of forms, by German manufacturers, abounded in all the mechanical departments. The international trial of mowing and reaping-machines took place July 9th, 1873, at Siebenbrunn, near Vienna, where measured fields of grass had been secured. The English makers had large numbers of mowers and reapers on exhibition, but foresaw defeat if they attempted to compete with the Americans, and so declined the trial. The Germans alone competed. The result was an overwhelming triumph of the American machines.

HEATING AIR.

JAMES A. MORRELL, of New-York, proposes to heat air by forcing it through pipes or chambers containing coils or plates of zinc and copper alternated, or other diverse metals such as are capable of inducing voltaic action, and employing air so heated to warm buildings, cars, etc., for evaporating and granulating sugar, and other purposes in the arts.

THE red-headed woodpecker has been seen by Prof. C. A. White piercing holes in the bark of the maple-tree. On examining the trees, Prof. White found their trunks perfectly sound; but the birds had bored many holes of the usual size through the bark and into the cambium layer, where they stopped. The sap was flowing freely from the holes; and, on watching the movements of the birds after they had returned to the tree, it was plain that they were sucking the sap, and that they had pecked the holes for the purpose of obtaining it.

BIOGRAPHY.

RICHARD ANTHONY PROCTOR.

[WITH PORTRAIT, PAGE 552.]

TEN years ago, the name of Richard Anthony Proctor was absolutely unknown; five years later, it was familiar in scientific circles in London, but comparatively unheard of outside; and to-day, it is familiar as household words to every educated man in England, and to many thousands in this country. Yet, the man who in so brief a space has conquered fame, and attracted the respectful admiration of astronomers in both hemispheres, is only thirty-six years old now, and did not begin to study astronomy till he had passed his five-and-twentieth year. Barely eight summers have flown since his maiden work appeared, and in the interval he has contributed a score of volumes to the library of science, some of them profound, many of them entirely original, and all of them thoroughly elevating and purely philosophic in tone. In addition to these works, Mr. Proctor has written constantly and voluminously in most of the leading English periodicals, and has fought successfully more than one brilliant and stoutly contested battle with some of the oldest and ablest *savants* in Europe.

Richard Anthony Proctor was born at Chelsea, England, on March 23, 1837.

Last year he published no fewer than five books—*Essays on Astronomy*, *School Atlas of Astronomy*, *Orbs Around Us*, *Elementary and Physical Geography*, and *Chart of* 324,000 *Stars*. From this brief *résumé* of his labors, it will be seen how much valuable and lasting work Mr. Proctor has contrived to crowd into a few years. As an astronomer and mathematician, he stands in the front rank of scientists, and to the most assiduous application and untiring industry he adds a brilliance of imagination, lucidity of style, and a daring originality of purpose that give him a distinct and honorable place among the select and illustrious few who have widened the boundaries of exact knowledge, and devoted great intellectual power to the elucidation of some of the grandest themes in the arcana of the sciences. In 1873-4, he visited the United States, and delivered a series of brilliant lectures upon astronomy in various cities. He was everywhere received with enthusiasm by crowded audiences.

JOSEPH GILLOTT.

[WITH PORTRAIT, PAGE 84.]

THE early history of the steel pen is curiously obscure. The most diligent search fails to discover the first maker or the earliest date of this implement. There were steel, or rather iron, pens—made, we believe, in Holland—as early as the middle of the seventeenth century. Toward the close of last century, Mr. Harrison, an ingenious Birmingham mechanic, made steel pens for Dr. Priestley. One of them is nothing more than a tube turned out of a flat strip of metal, with the sides and point filed away into the shape of a pen. The first actual supply of such pens, it is believed—the authority for the statement is no more than local tradition—was made by a Sheffield workman, whose name is forgotten. From time to time, as far back as 1809, steel pens, hand-fashioned, turned and filed, were made as curiosities or luxuries for presents; but it was not until about 1824 that such instruments were produced in considerable quantities, as regular articles of manufacture. Mr. James Perry was the first manufacturer; but the process was tedious and costly. The metal was steel, rolled out of wire, and for this Mr. Perry paid as much as seven shillings a pound. To the first person he employed, he gave five shillings for making each pen; and even when the trade had become regular, he gave for some years as much as thirty-six shillings per gross to his workmen. Now—thanks to machinery and modern improvements—pens, not very good, perhaps, but that will write, can be made and sold at a profit for 3½ cents per gross!

The first great impulse to the steel-pen trade was given in 1820, when Joseph Gillott began pen-making, and since then his name has become so closely identified with the trade, and has acquired such a world-wide reputation, that he has come to be regarded as *the* pen-maker.

He was born in Sheffield, on the 11th of October, 1799, the son of a workman in the cutlery trade.

In 1872, Mr. Gillott employed about 450 persons, the manufacture of pens reached more than five tons per week, and the prices were reduced from one shilling each to a few pence per gross—all the work of the active brain and skillful hand of one industrious and able man.

His chief characteristics were remarkable quickness and accuracy of observation, wonderful shrewdness, common-sense, and frankness; boldness, decision, and enterprise; rare mechanical skill and constructive powers; special talent for arrangement and organization, and rapid and sound judgment on all matters that came before him.

BARON VON LIEBIG.

[WITH PORTRAIT, PAGE 4.]

THIS illustrious chemist and author died at Munich, in April, 1873, at the age of 70 years. He first advocated the use, as fertilizers, of bones rich in phosphates. These he found resisted decomposition in the soil, and produced little effect; so he invented a mode of treating them before use with sulphuric acid, thus creating one of the most prosperous agricultural industries, the fabrication of superphosphates. The results at once obtained were marvelous. In England, the turnip crop doubled, and the employment of the new fertilizer became general; then it came into use in France, then Germany, and finally in this country.

There was a precocity in Liebig's genius. At nineteen years of age, he was a doctor of medicine, and at twenty-one assumed a professorship in Giessen University. Two years later, he founded his celebrated laboratory and school, which have since formed models for similar institutions throughout the world. If the motive which underlaid his writings can be expressed in a single sentence, we should say that it was the desire not only to be useful, but to be useful immediately. Hence his works relating to practical agriculture, and hence the instruction written for the people and not for the *savants*.

Justus von Liebig, his writings and his precepts, will be remembered and heeded even so long as man shall seek his sustenance from the bosom of his mother earth.

PROFESSOR JOHN WILLIAM DRAPER.

[WITH PORTRAIT, PAGE 192.]

BORN at St. Helens, near Liverpool, in 1811. Completed his medical education at the University of Pennsylvania, 1836; appointed Professor of Chemistry in the University of New-York, 1839. From an early period, Dr. Draper made for his special study the chemical action of light. It had always been supposed that the decomposition of carbonic acid by the leaves of plants was due to the violet rays. But Dr. Butler demonstrated that the deoxidizing action was done by the yellow rays, and that the violet were inoperative.

In 1842, Dr. Draper discovered that not only might the Fraunhofer fixed lines in the spectrum be photographed, but that there exists a vast number of others beyond the violet, which up to that time had been unknown. He also found three great lines less refrangible than the red, in a region altogether invisible to the eye. Of these new lines, which more than doubled in number those of Fraun-

hofer, he published engravings. He also invented the instrument for measuring the chemical force of light—the chlor-hydrogen photometer.

His memoir, *On the Production of Light by Heat*, published in 1847, was an important contribution to spectrum analysis; among other things, it gave the means for determining the solid or gaseous condition of the sun, the stars, and the nebulæ. In this paper, he established experimentally that all solid substances, and probably liquids, become incandescent at the same temperature; that the thermometric point at which such substances are red-hot is about 977° Fahr.; that the spectrum of an incandescent solid is continuous, it contains neither bright nor dark fixed lines; that from common temperatures up to 977° Fahr. the rays emitted by a solid are invisible, but at that temperature they impress the eye with the sensation of red; that the heat of the incandescing body being made continuously to rise, other rays are added, increasing in refrangibility as the temperature ascends; and that, while the addition of rays so much the more refrangible as the temperature is higher is taking place, there is an augmentation in the intensity of those already existing.

Thirteen years subsequently, M. Kirchhoff published as his own the same facts under the guise of mathematical deductions, with so meagre a reference to what Draper had done that he secured the entire credit of these discoveries. In an historical sketch of spectrum analysis subsequently published, Kirchhoff avoided all mention of his American predecessor.

Dr. Draper was the first person who succeeded in taking portraits of the human face by photography. This was in 1839. He published a minute account of the process at a time when in Europe it was regarded as altogether impracticable. He also was the first to take photographs of the moon.

Dr. Draper was the first person to obtain photographs of the diffraction spectrum given by a grating, and to show the singular advantages which that spectrum possesses over the prismatic investigations on radiations. In a memoir on the production of light by chemical action (1848), he gave the spectrum analysis of many different flames, and devised the arrangement of charts of their fixed lines in the manner now universally adopted. A memoir on phosphorescence contains the experimental determination of many important facts in relation to that property.

Our space does not permit enumeration of a tithe of the many new and original discoveries made by this remark-

able man. He undoubtedly stands at the head of living scientists. Among his more recent contributions are two short memoirs: one on the *Distribution of Heat in the Spectrum*, showing that the predominance of heat in the less refrangible regions is due to the action of the prism, and would not be observed in a normal spectrum, such as is formed by a grating; and that all the rays of light have intrinsically equal heating power. The second is an investigation of the distribution of chemical force in the spectrum. All the scientific researches to which so many years of his life have been devoted have been at his own expense: he has never received any extraneous aid, though many of them have been very costly. He has never taken out any patent, but has given the fruits of his investigations and inventions freely to the public. (77)

MR. J. N. LOCKYER, F.R.S.

[WITH PORTRAIT, PAGE 252.]

MR. JOSEPH NORMAN LOCKYER is a young astronomer who has cultivated his science assiduously, and made his mark as an investigator in the field of solar physics. He was born on the 17th of May, 1836, at Rugby, in Warwickshire, England. He inherited from his father a predilection for scientific studies; for, if the elder Lockyer had not the honor of being the first, he was one of the first who contrived methods of telegraphing by electricity.

In 1865, in recognition of his services as an astronomical observer, he was elected a Fellow of the Royal Astronomical Society.

Solar observations had for some time attracted much of Mr. Lockyer's attention, and in that year he propounded his method for observing the grand solar phenomena of the red flames with the spectroscope at any time when the sun is visible, whereas previously it had been impossible to see them except under the obscuration of a total or annular eclipse.

Mr. Lockyer has prosecuted his spectroscopic researches on the sun with great industry and fruitful results, and, in conjunction with Prof. Frankland, of the Royal School of Chemistry, has made a series of interesting experiments on the relation of gases under pressure to the spectrum lines, thus throwing important light on the changes taking place in the solar atmosphere.

Mr. Lockyer's contributions to scientific literature, as an author of books, a periodical writer, and a scientific editor, have been numerous. He is a gentleman of courteous and affable manners, a vivacious conversationist, and a ready and fluent public speaker. (77)

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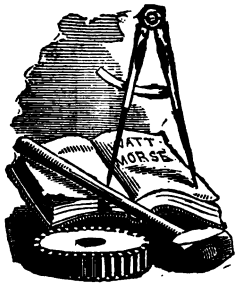

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